term 'dark' is now limited to the visible spectrum. Some objects are recognized as Bok globules. A short summary of our current understanding of the Milky Way galaxy is given. Tables of the objects, a glossary, further references, and an index conclude the book.

If I have one small quibble it concerns the arrangement of the illustrations upon the pages. These, particularly where comparisons with the past are presented, are often spread over as many as five pages. But the captions are always collected upon the first of those pages, hindering their practical usefulness. Cost probably precluded a larger format, but it would definitely have been better. And for the British reader, I would have preferred the terms (photographic) fixer instead of fixator, and (sodium) thiosulfate for hyposulfite.

This small point aside, I can thoroughly recommend this book. It clearly is the product of a huge amount of research and observational effort. It is written with authority and has a flowing style, and crammed with the fascinating detail that only such practical specialists in this field can provide. Patrick Moore would have approved! — Richard McKim.

Models of Time and Space from Astrophysics and World Cultures. The Foundations of Astrophysical Reality from Across the Centuries, by Bryan E. Penprase (Springer), 2023. Pp. 305, 23·5 × 15·5 cm. Price £27·99 (paperback; ISBN 978 3 031 27889 1).

When you first leaf through this book, you get the impression of an all-around blow of the changes in knowledge about space, time, and matter. The extensive table of content ranges from Polynesian navigation, early star maps, Kant's philosophy, Einstein's relativity, quantum physics, dark energy to the multiverse. The cover symbolizes this mixture, showing a surreal collage of Tehran's monumental Azadi Tower, placed with shadowy persons on a lunar-like surface with the glowing Fingers of Creation in the background. How does the author manage to fit the wide-ranging topics into a 300-page book? Is he a polymath with a clear concept or are we faced with a hodgepodge of popular snippets of knowledge?

Bryan Edward Penprase has studied physics at Stanford University, receiving a PhD in astrophysics from the University of Chicago. Currently, he acts as Vice President of Sponsored Research and External Academic Relations at the private Soka University of America (SUA) in Aliso Viejo, California. We read in the introduction: "The deeper cultural roots of astrophysical reality and the ways in which space and time craft objective reality and our subjective experience are typically not part of the discussion in university classes." This deficit has motivated Penprase to offer a suitable course at SUA that "enables students to comprehend how physics and astrophysics shape our observable universe and how the process of building a cosmic perspective creates a deeper understanding of the human condition that transcends cultures and makes us all 'planetary citizens'." The book is based on his lectures and is aimed at readers "interested in the fields of historical and cultural astronomy, as well as for anyone interested in learning about the latest finds from the field of physics and astrophysics." Does it live up to these high standards?

The soft-cover book is printed on high-quality paper, a good choice given the many full-colour illustrations, showing historical charts, modern astronomical images, or graphics (some made by the author himself). Presentation and layout of the medium-format publication are convincing. The text is fluid, informative, and easy to understand. It contains a few mathematical calculations (*e.g.*, for time dilation) and formulae, like the Maxwell equations. The content is organized more or less chronologically and reflects the current state of knowledge. There are 15 chapters with up to nine subchapters. References (literature, internet sources) are given below each chapter.

The first three chapters deal with early views on geography and the starry sky. We learn a lot about ancient cultures, the first astronomical instruments, and historic star charts. Many illustrations may be new to the reader. However, some (like Morden & Berry's 1690 world map) are too detailed for the format chosen. Chapter 4 profiles important figures in astronomy for their practical and theoretical achievements, featuring objects, innovative instruments, and methods. We meet Hevelius, Huygens, Cassini, Bradley, Descartes, Newton, Wright, and Kant. They are followed in the next chapter by other giants — people and telescopes. Herschel and Lord Rosse are celebrated for their revolutionary reflectors that revealed the nature of the Milky Way and the spiral structure of galaxies, respectively. We have now arrived at the transition from the 19th to the 20th Century with their large refracting telescopes erected at Lick, Yerkes, and Lowell Observatory. Chapter 5 covers the revolutionary achievements of astrophysical methods, especially spectroscopy. The Mount Wilson Observatory with the 100-inch *Hooker* reflector is representative of the enormous development. Hubble determined the distance of the Andromeda Nebula, confirming the extragalactic nature of galaxies, and discovered the expansion of the Universe, represented by Hubble's law. This led to the idea of a Big Bang.

Penprase now turns to an essential source of astronomical information: light. Its finite and invariant speed paved the way for Einstein's Theory of Special Relativity. It ultimately led the genius to General Relativity, treated in Chapter 8, the largest in the book. Newton's ideas about space, time, and gravity were changed fundamentally. We learn about the strange predictions of Einstein's theories and how they were tested. Black Holes and relativistic cosmology close the chapter. Another giant instrument symbolizes this era: the giant 200-inch *Hale* reflector on Palomar Mountain. It proved Hubble's law to enormous distances, where extreme objects, like quasars, were discovered. The instrumental progress, driven by new questions arising from the data, was unstoppable. It led to satellite astronomy, represented by the *Hubble Space Telescope*, the *James Webb Space Telescope*, and *Gaia*. The latter instrument revealed the construction of the Milky Way, finalizing Herschel's work. The following chapter shows how telescopes on Earth and in space revealed the large-scale structure of the Universe. In this course the author discusses the existence of a cosmic horizon, 46-billion light years away, which limits our observable universe. On the other hand, detailed ideas about the early Universe were developed due to the discovery of cosmic background radiation and new theoretical concepts such as inflation.

In the next three chapters, Penprase turns the attention to the microcosm. The quantum world is a strange place, governed by uncertainty and probability. The works of Curie, de Broglie, Heisenberg, and Schrödinger are discussed, leading to quantum mechanics. Photons, electrons, and protons were just the first members of a fast-growing zoo of particles, found experimentally and eventually arranged in the Standard Model. Its keystone is the Higgs boson, predicted in 1964 and detected at CERN in 2012. The author also addresses the essential role of quantum physics in the Big Bang and black holes — this is where the microcosm and macrocosm meet.

Chapter 14, 'Exploring the Invisible Universe', is a collection of speculative objects or concepts that have arisen from observations or theoretical considerations. Examples are Sirius B, planet X, neutrinos, black holes, gravitational waves, and dark matter/energy. Some cases are closed, others are still open, like a ninth planet (in place of poor Pluto) or the dark fractions of the Universe. The book ends with the 'Physics of the Vacuum and Multiverses'. That chapter contains an interesting review of Freeman Dyson's important essay, *Time without End: Physics and Biology in an Open Universe*. Published in 1979, *i.e.*, before the discovery of accelerated expansion, it offers an astonishing look at the future of an ever-expanding universe.

The wide range of topics obviously fits into a 300-page book — the content is anything but a hodgepodge. Penprase provides a competent and up-to-date overview of important scientific and historical aspects of astronomy and astrophysics. He succeeds in turning his ambitious university lectures into a book for the general reader. The common thread is the cultural anchoring of ideas about space, time, and matter. That's the bright side of the book — but sadly there is also a dark one.

In my private hit list of reviewed books with the most errors found, Penprase's unfortunately ends up in one of the top places. If they arose during the publication process, the author must be blamed for not carrying out a thorough final check. In the opposite case, one would have to question his expertise. Since no systematic pattern can be seen in the occurrence of the errors, I suspect that both Penprase and Springer are responsible for them. The severity of the errors ranges from mere typos to wrong content. We find them in the ordinary text, figures/captions, references, and index. Some are systematic in nature, particularly when it comes to incorrect spelling of names or inconsistent capitalization. For reasons of scientific seriousness and historical accuracy, I cannot dispense with my findings. So, the review has a perhaps boring but necessary second part.

Let's start with incorrect first/last names (the correct one is given in [ ]). In almost half of the cases, the text contains both the correct and incorrect spelling, sometimes just a few lines apart. We have: Bernard [Barnard], Curtiss [Curtis], Durer [Dürer], Francois Englert [François], Francois Arago [François], Friedman [Friedmann], Harlowe Shapley [Harlow], Herchel [Herschel], Johan Galle [Johann], Johann Hevelius [Johannes], Joannes Regiomentanus [Johannes], LangevinJolliot [Langevin-Jolliot], Leibnitz [Leibniz], Lemaitre [Lemaître], Martin Schmidt [Maarten], Michelle [Michell], Nevill Maskelyne [Nevil], Nicolaus Visscher [Nicolas], Percivall Lowell [Percival], Rene Descartes [René], Roemer [Rømer], Roentgen [Röntgen], Scrobosco [Sacrobosco], Schrodinger [Schrödinger], Steven Hawking [Stephen], Wein [Wien]. The last case appears as "Wein Displacement" on page 170, which should read "Wien's displacement law". The index contains 11 of these names, four are incorrect, three correct, and four indifferent (*e.g.*, Shapley, H.). The references mostly give the correct spelling, exceptions are "Schrodinger", "Lemaitre", and "Rene Descartes".

Next some examples of inconsistent capitalization (often concerning proper names): lick / Lick, Yerkes observatory / Observatory, black body / Black Body, Higgs boson / Boson, helium / Helium, hydrogen / Hydrogen, general relativity / General Relativity, dark energy / Dark Energy, Hubble Space telescope / Telescope, dark ages / Dark Ages. On page 203 we read "The Discovery of the CMBR..." and in the author's Fig. 13.2 we find "Quarks Combine" (but "nuclei form"). An interesting case appears in the references of Chapter 7: "Phillips, T. (2022). *James cook and the transit of venus*". Aperture is not given consistently, writing 36″ and 36". The focus length issues on page 55 look like typos: "150-long lens telescope" [150-feet long lens telescope] and "150 feet-" [150-feet].

Other cases are "WIMPS" [WIMPs], "TypeIa supernovae" [Type Ia] and "2015" [1915] for the year of Einstein's Berlin talk. Some terms look cryptic, like $\pi + > = ud >$ on page 236; it should be $\pi^{+} = < ud >$.

Examples of errors concerning figures and captions: Fig. 4.5 presents "drawings of Saturn" — we see Jupiter. Fig. 5.1 should show "Herschel's 48-inch diameter reflecting telescope" — this is his 18·7-inch reflector. On page 80 the captions of Fig. 5.3 and Fig. 5.4 are swapped. Fig. 10.2 shows our emitted radio signals, now reaching a distance of 125 light years. The circular region (looking more like an oval) correctly contains nearby stars like Capella, Aldebaran, and Arcturus, but curiously also the Coma Cluster of galaxies, 330 million light years away! In Fig. 10.7 we see data of the *Wilkinson Microwave Anisotropy Probe* (*WMAP*), called "Wilkinson Microwave Anisotropy Explorer" in the caption, while the text on the facing page gives the correct name. According to the author, Fig. 10.10 shows "the shape of the light cone". Actually, the popular graphic does not show the light cone, but the scale function R(t), giving the distance between remote objects depending on cosmic time. In an expanding universe the light cone is pear-shaped. This error is systematic. Fig. 12.4 shows the particles in Gell-Mann's diagrams of the SU(3) symmetry group (the theory is incorrectly termed "8-fold path", instead of "eightfold way"). Among them is the Ω (a fermion), called "W-boson" in the caption (the same appears in Fig. 12.5). In Fig. 12.7 the shown Λ hyperon is wrongly called "L particle". Obviously, there is a problem with uppercase Greek letters.

Finally, we come to content errors, the most critical category. Here is a selection. On page 25 we read that Aristarchus has placed the Moon "at a distance of about 70 Earth radii" — the canonical value is 19. On page 49 the author writes: "Flamsteed's chart pioneered the use of labelling stars in order of their brightness with a number, a designation which we now call 'Flamsteed numbers'." The British astronomer did not label the stars. Moreover, the numbers (later introduced by Bode) order the stars by right ascension and not brightness. This is particularly strange because Penprase cites my paper on the subject in the references, which gives the correct version! Newton's *Principia* was published in 1687, not in 1686 (p. 67). On page 74 it is claimed that Herschel has developed a "catalog that included the positions of thousands of galaxies and faint stars". Actually, he published three catalogues, listing in total 2500 nebulae and star clusters — but no faint stars. Object positions (coordinates) are not given. It is also claimed that Herschel used a platform "where he could lay flat for many hours with a view of the sky". He never did this, but always stood on the platform and looked through the eyepiece at the tube opening. We further read that he "discovered many new comets" — there were none! In the references to Chapter 8, Herschel's 1785 paper is cited, writing "*Read at the royal society*" (note the lower-case letters); the journal *Philosophical Transactions of the Royal Society* (plus volume and page) is not mentioned. On page 81, Penprase claimed that the Fourth Earl of Rosse observed "Mars' two moons in 1877". Only the outer moon, Deimos, was seen (by Dreyer and Rosse). Obviously, this error is due to an often-used source (N. English, 2018*). On page 82 we read that a white dwarf has an "inert core of Helium and Carbon" — there is no helium in the core. Fig. 8.9 and Fig. 8.10 on page 144 are misleading. The former plots a "beam of light in a curved space" as a straight line, which makes no sense; light must follow the curved coordinate lines! The latter shows the case in flat space. On page 174 the author writes that Bessel and Fraunhofer measured star positions. Fraunhofer constructed an excellent refractor for

*See review in *JAHH*, **26**, 964, 2023.

Bessel, but his own measurements are neither mentioned in his publications nor in the surviving manuscripts. On page 183 we learn that the galaxy NGC 7320, located in the foreground of Stephan's Quintet in Pegasus, is a member of the Virgo Cluster. This is ridiculous — the galaxy cluster is located on the opposite side of the sky! On page 255 the violation of "CP parity" is mentioned. However, because CP already stands for "charge and parity", we have an unnecessary repetition. Chapter 13.3 is titled "Supersymmetry and Symmetry Breaking" but the latter subject is not treated.

It looks like I'm pretty pernickety. Some problems are certainly a matter of opinion, but ultimately there are too many errors for such an ambitious book. The reader should expect a flawless and consistent presentation. — Wolfgang Steinicke.

More Than Curious: A Science Memoir, by William H. Press (Darwin-Finch Publishing Company), 2023. Pp. 589, 22·9 × 15·2 cm. Price $15 (about £12) (paperback; ISBN 979 898954972 6).

I've never met Bill Press. I've never corresponded with him. I've seen him once.* But after having read this book, I feel that I've known him all my life, or even all his life. At 589 pages, this is a rather long memoir, but it is the short version. A longer one, with more details on things probably of interest only to his family but also containing things he doesn't want made public until after all concerned will have died, is in escrow and will be made available "someday... but not soon". Maybe I'll live that long. At times, I thought that I must have got the long version by mistake, as the memoir is very candid. (Whether it is honest can be judged only by those involved, though I do recognize many of the names and have met some of the corresponding people and in those cases Press's descriptions usually jibe with my experience, even if separated by decades — some folks never change — so perhaps I can assume that the rest is equally honest.) Feelings are probably mutual, as I've heard some stories about Press which I won't repeat here.

Press was born in 1948 in New York City, of Ashkenazi Jewish heritage, moved with his parents to California in 1955 (his geophysicist father Frank becoming a professor at Caltech; in 1965 he moved back east to MIT), attended Harvard as an undergraduate, was a doctoral student at Caltech (with Kip Thorne), briefly a postdoc at Caltech, an assistant professor at Princeton, a professor at Harvard from 1976 (when he became the youngest professor up until that time) to 1998 (and 1982–1985 chair of the astronomy department). He then went on to become deputy laboratory director at the Los Alamos National Laboratory (LANL) before moving to the University of Texas at Austin in 2007 and switching fields somewhat, becoming a professor with a joint appointment in the computer-science and integrative-biology departments. He and his first

*That was at a conference in Melbourne in 1995 where, before his talk, he introduced himself to the audience as the front end of the Press–Schechter horse. Paul Schechter was sitting in the audience behind me. It was a conference on gravitational lensing. There was a debate about the value of the time delay between variations in the two images of the gravitationally lensed quasar 0957+561, the first gravitational-lens system discovered[1], with a shorter delay implying a larger Hubble constant and *vice versa*. (That mirrored the general debate about the Hubble constant; at the time the 'tension' was between 50 and 100 km/s/Mpc.) Press was wrong in that case. I was watching from the wings while the Hamburg group got it right[2,3]. Most have probably forgotten that now; perhaps more will remember his quip, still true today, that someone knows the Hubble constant to two significant figures, but we don't know who that person is. To his credit, Press, in an aside to another story involving potential extraterrestrial intelligence, admits that his two papers on this topic were "just incomprehensibly *wrong*" [his emphasis].