

involvement is also beneficial, to me at least, because numbers are not a natural entity like exoplanets or protons, and although they are essential to our exploitation of matter they excite so much emotive enthusiasm, particularly in the truly gifted mathematician, that the scientific integrity of their reality may be imperilled. It is relevant that the author mentions Einstein's comment "I have trouble with Dirac".

I found 'ten infernal minutes', the chapter dealing specifically with the Big Bang moment, particularly interesting and well presented, with the uncertainty principle applicable to the ultimate pre-Bang small dimension giving rise to quantum fluctuations with balanced positive and negative energy aggregated to zero but capable of expanding to become the Universe. Alan Guth's "ultimate free lunch" is quoted, before the author goes on to describe the subsequent and more easily comprehensible establishment of the four fundamental forces and then of particles. To what extent this vacuum-energy concept is now generally accepted I do not know, but it is certainly more interesting than simply calling the episode a singularity.

Towards the end of the book there is a lot of information about modern space and particle exploration, the effect of politics and international co-operation, and the increasing involvement of wealthy individuals — Elon Musk, SpaceX, Virgin Galactic, Burt Rutan's aircraft — all of which leaves the reader with an impression of worldwide activity which may lead to major discoveries and even the much heralded Grand Unified Theory of Everything. But will it? The chief merit of this book is to make the reader think about all aspects of cosmic knowledge, and as indicated above our basic ideas have not changed much since 1952 but the puzzles revealed by our on-going discoveries have multiplied. Towards the end of the book the author mentions the growth of artificial intelligence and its success (particularly in playing chess) but proffers the final cheerful conclusion that the human mind has the potential to continue to spearhead the research that may ultimately hit the gold; and Hilaire Belloc's definition of genius — "the ability to think in a very large number of categories" — is perhaps a pointer in this regard.

A few more mundane comments in conclusion are that the Foreword to the book is unnecessary and that a glossary would as always be a boon to the reader. Also the author refers in a speed-development context to the "legendary Marquise" car of *c.*1900. I know of no automobile of that name and I think he means the Mercedes developed in 1901 from the Cannstatt Daimler of 1899. But these minor criticisms, and a little prolixity here and there, do not mar a book which I found comprehensive within its remit, conspicuously demonstrative of its author's expert knowledge and enthusiasm, and thought provoking to an extent that might make it of interest to the professional astronomer as well as the layman. — COLIN COOKE.

Fundamental Ideas in Cosmology: Scientific, Philosophical and Sociological Critical Perspectives, by Martín López-Corredoira (IoP Publishing), 2022. Pp. 244, 26 × 18.5 cm. Price £99/\$120 (hardbound; ISBN 978 0 7503 3773 1).

This book is something of a curate's egg, but well done. The subtitle gives an idea about the contents: it is mainly about the pillars of the standard model of cosmology (expansion, dark matter, dark energy, the CMB, big-bang nucleosynthesis, structure formation) and alternative explanations for various aspects. Film critic Roger Ebert once said "It's not what a movie is about, it's how it is about it", meaning that in reviewing a film one needs to

distinguish the topic of the film from the expertise of the director; it is possible to like either, both, or neither. I don't agree with many of the points (some in contradiction with others) presented by the author, but that is not a problem as one point of the book is to present a diverse range of views. I don't always agree with his own views (which he sometimes mentions), but that is not a problem because another point is to encourage discussion and debate.* Both are needed. However, I sometimes disagree with the way various arguments are presented, which is my main complaint about the book. Also, as with a liberal or conservative newspaper, sometimes the problem is not with the facts themselves nor with their presentation but rather with their selection.

The good part is that the book provides not only a good summary of the standard model but also of alternatives to it, from the sublime to the ridiculous. (A minor gripe is that that spectrum might be a bit too broad.) With a total of 969 references (including titles), most of which are to articles from major journals in the field and most of which are relatively recent[†], both the standard model and its alternatives are well documented for those who want to explore the details; with such a broad scope, the book can be only an introduction to the science it covers, which it does well in the first seven chapters. It is rare that someone is so well informed both about standard cosmology and alternative theories. There are good summaries of the inflationary paradigm and the history of dark matter, mentioning details often glossed over in similar books. The last three chapters examine sociological and cultural factors and the author's own stance.

López-Corredoira is on the staff of the Instituto de Astrofísica de Canarias (IAC) on Tenerife and has a large number of publications on a wide range of topics, mainly on cosmology and extragalactic astronomy but also on the history, philosophy, and sociology of science. He describes himself as “a philosopher-scientist, within a realist, materialist and sceptical tradition of continental European philosophy, but steadfastly eschewing from postmodern approaches”, thus a man after my own heart. Nevertheless, although we both support the general goal of scepticism and debate, we disagree to some extent on what should be considered reasonable and some of the explanations for why cosmology has taken the course it has. While it is certainly the case that few alternative theories are taken seriously by most of the community, and while it is probably true that it is more difficult to get funding for research on such theories, which does mean that they are less well developed than the standard model, I don't think that is the only, or even the main, reason why they have not been as successful. In most cases, they just aren't as good and couldn't be improved even with considerable effort. While in the book the standard model is approached sceptically, alternatives to it aren't subjected to the same criticism (while the author argues that the reverse is what happens in practice, which is probably true in a minority of cases). Apart from distinguishing too little between well-founded (but wrong) theories by professional scientists and ideas based on misunderstandings by amateurs, some of the alternative explanations have been convincingly rebutted, but such rebuttals (as well as observational data which rule out such explanations) are often not mentioned. That gives the impression that the predominance of the standard model is due more to sociological factors

*A couple of months ago, I was part of a discussion on the decline of debate in cosmology. We agreed that there was probably more debate in the past and that there should be more debate now, but also that it should be civil: debate about the issues as opposed to attacking others.

[†]Such details are conveniently provided in the appendix.

than is actually the case. (That has also changed with time; I would agree that when the Einstein–de Sitter model was the standard model, the primary reasons for it were not scientific.) Whatever one thinks of Kragh’s argument¹ that Nobel Prizes awarded for work in cosmology imply that cosmology is a respectable science, it is at best inconsistent to criticize Kragh’s argument while at the same time always mentioning Alfvén’s Nobel Prize (which was not for cosmology) in connection with his unorthodox ideas about cosmology.

I don’t think that cynicism helps the debate, *e.g.*, comparing the age of the Universe of 13.787 ± 0.020 Gyr with the calculation of the age of the Earth by Bishop Ussher, as if the former is just as doomed to become obsolete as the latter. Some claims stated as fact are simply wrong, such as that dark energy was invented to explain the magnitude–redshift relation for Type Ia supernovae. First, no sort of dark energy other than the cosmological constant is needed to explain such data, and second it was present already in the first paper on relativistic cosmology² and, though some set it to zero for simplicity, was often used as a free parameter in cosmology in the following decades³. Citing references (*e.g.*, ref. 4*) for wrong claims, such as that ‘concordance cosmology’ implies only that there is one set of parameters which fits all observations but not that there is an independent confirmation of any single parameter, or that non-detection of dark-matter particles at some arbitrary time (and ignoring the fact that dark matter might be in some other form) should rule out Λ CDM, doesn’t help. In such cases, I hear an axe being ground. Other claims are probably due to confusion shared by many, such as a conflation of the ideas of fine-tuning and the Anthropic Principle.

Like other books in the ‘IOP ebooks’ series, using a chapter–page-numbering scheme, rather than consecutive page numbers, is distracting and doesn’t seem to serve any purpose. The book is well structured but chapter (even pages) and section (odd) running heads would be useful; instead, all running heads are just the title of the book. There are a few diagrams, most in colour, throughout the text and notes are footnotes rather than endnotes. There is no index, but one would be useful in a book such as this, which would also benefit from proof-reading/editing, especially by a native speaker of English. References are at the end of each chapter.

I can’t unconditionally recommend the book, mainly because, similar to López-Corredoira’s criticism of Merritt⁶, it sometimes tries to be an objective judge and proponent of one side at the same time. While I would always hesitate to recommend a book I see as fundamentally wrong, something which is obviously an opinion piece promoting one side of an argument is easier to deal with and can be used for at least getting an overview of a certain side in a debate. This book is neither. On the other hand, there is much information here which would require many sources and much work to duplicate and the book could prove a valuable resource as a jumping-off point for those interested in learning about debates in modern cosmology, but readers will have to judge for themselves which debates are actually worth worrying about. — PHILLIP HELBIG.

References

- (1) H. Kragh, *Phys. Phil.*, **008**, 14, 2007.
 (2) A. Einstein, *Sitz. Ber. Königl. Preuss. Akad. Wiss.*, **VI**, 142, 1917.

* Interestingly, later in the book the author shares my criticism⁵ of Merritt⁶ trying to be simultaneously judge and jury.

- (3) S. M. Carroll, W. H. Press & E. L. Turner, *ARA*, **30**, 499, 1992.
- (4) D. Merritt, *Stud. Hist. Phil. Mod. Phys.*, **57**, 41, 2017.
- (5) P. Helbig, *The Observatory*, **141**, 73, 2021.
- (6) D. Merritt, *A Philosophical Approach to MOND: Assessing the Milgromian Research Program in Cosmology* (Cambridge University Press), 2020.

FROM THE LIBRARY

The New Background of Science, by Sir James Jeans (The Macmillan Company, New York; Cambridge University Press), 1922. Pp. 301, 20 × 13.5 cm. Price not given; no ISBN number. Acquired by Clinton B. Ford in 1933 September; purchased at auction from the American Association of Variable Star Observers.

James Hopwood Jeans (who became Sir in 1928) may ring a couple of bells, first as the eponym of the Jeans length and mass and co-calculator of the Rayleigh–Jeans (long-wavelength) portion of a black-body spectrum. Faithful readers of these pages (both of you) will also recall that a biography of him, written/edited by his son, Christopher, appeared recently and was reviewed in these pages (**141**, 262, 2021). Seven of his (at least 12) books were intended for “the educated public” rather than for fellow scientists.

This one came somewhere near the middle, and the author explains the timing by saying: “After undergoing a succession of kaleidoscopic changes, theoretical physics appears to have attained a state of comparative quiescence.” Those kaleidoscopic changes were Special and General Relativity and the Bohr atom, later leading to the new quantum mechanics of Heisenberg, Schrödinger, and Dirac. Most of the chapters are devoted to explanations of the contents of these new portions of physics, Jeans apologizing that he cannot do this without “using a few mathematical symbols and formulae”.

Jeans then explains that he has tried to present the new physics (typically in contrast with 19th-Century ideas) “in such a way that every reader can form his own judgment as to its philosophical implications”. But throughout, the reader is given only two choices, between two ‘conjectures’, those of the idealist and the realist, and those of mentalism and materialism. Only the last of these four is likely to be too much misunderstood — Jeans did not mean valuing only the piling up of material things, but rather thinking that material things exist outside the minds of the valuers. Idealism then is not expecting the world to be or get better than it is but supposing that only minds and their ideas exist. Thus the equations of the physicist do not relate one real entity to another, but only our ideas of something to our ideas about something else.

A contemporary philosopher, L. Susan Stebbing (1885–1943) devoted a whole book, *Philosophy and the Physicists* (Methuen, 1937), to berating both Jeans and Sir Arthur Stanley Eddington for their “nebulous philosophy”. She was harder on Jeans than on Eddington, but both were censured for their desire to be entertaining in their writings and for appealing to emotion at “the level of a revivalist preacher”. If my copy should surface again, Prof. Stebbing (the first woman to hold such a position in England) might also feature in ‘From the Library’. But meanwhile, why might one have a go at reading Jeans? Perhaps because very few since have tried so hard to clarify the relationship between GR and QM and our naïve ideas about the world. — VIRGINIA TRIMBLE.