component of our DNA. The technocrats answer that a far-reaching technical endeavour such as a multigenerational starship will provide focus to such lives — a focus for human ambition. Well maybe, but again Regis notes that there are equally ambitious projects like universal health care, clean water, or contented fruitful lives for most of the Earth's human population which are also capable of providing focus and with a much more likely chance of success.

The British journalist and political commentator Marina Hyde describes a rhetorical technique used to oppose any piece of proposed government legislation or planning — a technique she calls "Whataboutery". Whataboutery describes an argument which highlights, and places penny-pinching obstacles, real or imagined, in the path that may inhibit the smooth acceptance of the proposal. "What about the financial markets?", "What about the housing stock?", "What about the farmers?". Whataboutery is particularly effective against the more ambitious proposals — what about the parking, for example, when discussing the development of a major power station. Whataboutery appears wise and thoughtful without the effort of having to argue an alternative approach, merely to point out potential difficulties. But Regis is not indulging in Whataboutery, or necessarily criticising ambition, but simply pointing out some hard facts. His discussion is not in the minutiae of small details but addresses the overwhelmingly vast lack of potentially capable technology.

The science-fiction writer Kurt Vonnegut says of *The Star Spangled Banner* that in a Universe of a gazillion civilisations no other has chosen an anthem of "gibberish sprinkled with question marks". Gibberish or not, to loyal patriots the song is inspiring and deeply meaningful. Poetry and dreams matter. As Ed Regis points out in the preface to this book, dreams have been responsible for scientific breakthroughs — he quotes the example of Kekulé and the structure of the benzene ring. There is a Flemish proverb, perhaps in relation to Bruegel's painting "and still the farmer ploughs" — perhaps we could add to that "and while he ploughs he dreams".

Perhaps the choice isn't necessarily between the hubris of ambition or the humility of the *status quo*, there is a middle way, as Daedalus discovered, to use tried-and-tested and carefully calibrated technology within the bounds of its capabilities. This excellent and thoroughly readable book guides our thinking and starship imaginings to follow Regis's ideal of not letting our dreams outrun what is possible and as he says, and delivers, in the final chapter: "What is needed is a severe and sober calculation of the odds". — Barry Kent.

Target Earth, by Govert Schilling (translated by Marilyn Hedges) (MIT Press), 2025. Pp. 120, 21 × 14 cm. Price $21·95 (about £17) (hardbound; ISBN 978 0 262 55134 2).

There is a story that Eric Clapton was given his first guitar, a metal-strung acoustic, at a very early age — perhaps five or seven years old. It had a particularly high action and the metal strings hurt his young fingers so he found it difficult to play and he gave up. Later and a bit older he tried again with a different guitar and the rest is musical legend. Many people have also given up playing music when their first instrument has been difficult and perhaps badly made. In spite of the lyrics by one-time Bristol-based singer Fred 'Leadbelly' Wedlock who claimed to have made his name singing "the folk tradition" — "With a yard of Spanish plywood and a capo" — a poor introductory instrument can be off-putting. I imagine there are generations of budding astronomers who have also been dissuaded by poor-quality beginner telescopes. Beginners' instruments

and beginners' introductory books need to be of sufficient quality that they do not discourage, but rather inspire learning while also being affordable so that the cost is not off-putting.

This book is not a detailed study of asteroids, comets, *etc.*, but rather a fast-paced romp through all such pieces of naturally occurring space debris that may come crashing down on Earth. As Schilling himself says "this slim book is not the place to discuss at length all the newest knowledge" — he was describing knowledge of the Solar System's origins in that sentence — but it applies generally to the entire book. This book is not a scientific treatise but a brisk scamper through the headline information about falling space rocks. I should also say that it is very comprehensive in that it addresses most of the issues and is certainly bang up to date. It is in that, not necessarily pejorative, sense that the book may be described as superficial. In just 96 pages of text Schilling describes the objects that have struck the Earth with minor or severe consequences. He lists the sizes, composition, and impact velocity of these objects and also describes their potential sources and possible disaster-mitigating actions.

Although there is certainly a place for this low-in-detail but all-encompassing account, it is a pity that Schilling doesn't help the more inquisitive reader by adding more references to the bits of space gossip that he uses. There are a few references scattered through the text, the odd web page, a list of six other books for further reading, and there is a brief index. Few of the named space rocks are included in it. I did find interesting and surprising pieces of information in the text, such as the eight-yard-diameter rock $2020VT_4$ which zoomed between the surface of the Earth and the *ISS* in 2020 November, or that *Philae*, the *Rosetta* lander investigating Comet Churyumov–Gerasimenko, lasted a few months after its unplanned hopping over the comet's surface and crashing under a cliff face. The existence of the *ATLAS* last-alert telescope system which spots potentially hazardous asteroids was also new information to me.

There is no doubt that Schilling provides a very clear account of the real hazards of space rocks to human civilisation and the measures being taken to guard against the consequence of impact — which in an emergency might involve evacuating the population of target sites. He also outlines the benefits, for example, that our civilisations, indeed our very existence, can be attributed to the catastrophic collisions of Earth with asteroids.

My overwhelming feeling is of a book executed within time and space constraints. It seems like a rush job, as if the instructions to the author may have been to write down everything you know about asteroids in under 100 pages. The author is very well informed — so he knows a lot and thus in such limited space everything is necessarily lacking a bit of depth. To some extent this works well with his easy conversational style of writing — although some things jar. I found the use of yards to describe the sizes of meteorites as rather strange. I feel that yards are primarily used for agricultural or sports-ground dimensions — vaguely technical things are usually described in popular science in miles, feet, and inches — even when there are hundreds or thousands of feet. Yards seem particularly odd when used for the depth of a bore hole. There are also some curious sentences that are just baffling: the Antarctic meteorite hunt which is described as "success assured" — why? Or that the triceratops and tyrannosaurus demise is with "no coincidence" at a geological boundary — again why "no coincidence"? Could these be issues of translation from the original Dutch to American English or is it just that lack of a bit more explanatory detail?

To come back to my first paragraph, could this book be described as a beginners' introduction as I suspect is its aim? It is certainly well made but at just under £20 for around 100 pages of text it probably isn't great value. But does it inspire and encourage? On balance — maybe. It is full of factual snippets without much 'how' or 'why' science. This strange brew might make a great gift for a fact-loving young person — maybe one of the same age as Clapton when he finally got around to enjoying the guitar. — Barry Kent.

The Whole Truth: A Cosmologist's Reflections on the Search for Objective Reality, by P. J. E. Peebles (Princeton University Press), 2022. Pp. 264, 22·7 × 14·7 cm. Price £18·99 (paperback; ISBN 978 0 691 23137 2).

This is a 'paperback review' of a book already reviewed in hardcover; as such I mention only some things related to the physical book and some matters not mentioned by Trimble in her review[1] of the hardback version, which I intentionally did not re-read before drafting this review. Peebles of course needs no introduction, but the cover reminds the reader that he won the Nobel Prize in Physics (in 2019). Like another book[2] from the same publisher that I reviewed[3] in these pages, the first thing I noticed were the unorthodox (though different) page headings; in that book, the chapter numbers and names are at the bottom of the page; this one follows the usual convention in that respect, though the page number is in square brackets and at a fixed distance from the name of the chapter or section, rather than from the edge of the page. There is a long preface explaining the motivation for the book, no figures, more than sixteen pages of references (including article titles; unusual but useful for a book of this type are author/year references in the text), and a six-and-one-half-page small-print index; there are a few, sometimes long, footnotes in the main text.

This book covers much of the same ground as his previous book[4] (reviewed by both Trimble[5] and me[6]), though the emphasis is different, something which is sometimes explicitly mentioned (p. 166): "Let us pass over the details entered in Cosmology's Century.... We are interested in the big picture." That holds for Chapters 3–6; the first two and Chapter 7 are relevant summaries of the history and philosophy of physics from the point of view of a physicist; my guess is that most working physicists agree with Peebles when he concludes, in spite of or perhaps because of knowledge of other ideas among philosophers, that something like objective reality exists and it is the job of physicists to study it. As always, I am happy when a real scientist is critical of Kuhn's idea of paradigm shifts (pp. 30–32), which I see as at best a caricature of the way science actually works. In several recent reviews I've complained about authors who should know better getting basic concepts in cosmology wrong; I can recommend Peebles' clear and detailed explanation of the Hubble–Lemaître law (pp. 92–93). In my review[6] of *Cosmology's Century*, I wrote that Peebles only briefly mentioned the flatness problem, although he did much to popularize it[7]. There is an entire section (6.4) on that and closely related topics here, presenting, in my view, a much more balanced approach. "You win some, you lose some."

Discussion of a 'fourth neutrino' might be confusing to those who are certain that there are only three; 'neutrino' is often used in a more general sense (*e.g.*, 'effective number of neutrinos') in cosmology, and in 1977 it wasn't yet clear that there could not be a fourth generation of elementary particles. For some reason, the unit 'Volt' is always capitalized, and "fact on the ground" — a phrase which I had never encountered before — or a variant of it occurs ten