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REVIEWS

Einstein in Oxford, by Andrew Robinson (Bodleian Library Publishing), 2024. Pp. 96, 20·5 × 13·5 cm. Price £16·99 (hardbound; ISBN 978 1 85124 638 0).

Ulm, Zurich, Bern, Prague, Berlin, Princeton. Most readers will immediately think of Einstein when encountering the names of those cities in which he lived. But Oxford? Einstein never lived in Oxford, but it is a place which he visited several times, first on his first trip to England in 1921 when he lectured in Manchester and London but also visited Oxford due to the invitation of Frederick Lindemann, professor of experimental philosophy (*i.e.*, physics). He returned at Lindemann's invitation in 1931, 1932, and 1933. Born in Germany, Lindemann was brought up and educated in England, though he returned temporarily to Germany in his teens for some schooling. He thought of himself as more English than the English and, in contrast to Einstein, had very conservative political views, but at the same time great respect for Einstein's science and for him as a person. On the same day I bought this book, just across the street I also saw the famous Einstein blackboard (which contains some mistakes) in the History of Science Museum (whose director, Silke Ackermann, one of many German-born English residents mentioned in this review, provides a foreword), which dates from his Rhodes Lecture in 1931 (which finally took place after several attempts since 1927 to attract Einstein back for a second visit); during that visit Einstein also received an honorary doctorate (with an oration in Latin, putting him into a similar situation as that of those who couldn't understand his lectures in German). The book's preface discusses the blackboard and the first chapter Lindemann and his invitations.

Chapter two discusses aspects of Einstein's work relevant to his 1933 Herbert Spencer lecture. When visiting Oxford, Einstein (sometimes living in Lewis Carroll's former quarters) also indulged his interests besides science, especially music. As the third chapter describes, that was well documented by Margaret Deneke (whose parents had been born in Germany; her mother was also a close friend of Clara Schumann). In addition to playing a borrowed violin, Einstein also sat for a portrait and, in 1933, gave the Deneke lecture on atomic theory. The fourth chapter explores other aspects of Einstein in Oxford, such as writing a (perhaps Carroll-inspired) poem about himself, appearing in a stained-glass window, and Lindemann's attempts to get Einstein elected as a Fellow of Christ

Church, hoping that he would spend a month or so each year there in return for a stipend of £400. He was indeed elected (on 1931 October 21), but Lindemann had to deal both with protests about money going to foreigners and with the tax office. His life in Oxford was not dissimilar to that in Germany, spending time sailing, walking, dealing with female admirers, and discussing politics.

The final chapter discusses Einstein as a refugee from Nazi Germany, making use of his Oxford connections to spend some time there in 1933, arriving from Belgium. Although Einstein noted that his connections with Oxford had grown stronger, he returned to Belgium *via* Glasgow and never came back to Oxford. He did return to England, though, discussing politics with Churchill and later, after hearing of assassination threats in Belgium, hid out alone for a while in rural Norfolk, guarded by Commander Oliver Locker-Lampson. On 1933 October 7, joined by his wife, Einstein boarded a ship in Southampton bound for New York. He never returned to Europe.

The book contains many quotations*, the sources for which appear on seven pages of the now-default small print, followed by two pages with a wide range of suggestions for further reading, a page of acknowledgements, and a three-page index. Robinson has written several books on a wide range of topics, including two others on Einstein; this one is well written and almost free of typos and questionable matters of style. This book provides an interesting glimpse of times and places often mentioned just briefly if not at all in other accounts of Einstein's life. (For an interesting collection of better-known anecdotes, see another book[1] reviewed[2] here not long ago.) Black-and-white pictures of Einstein (and others) in Oxford as well as of his poem (and its translation into English) and of Einstein in a stained-glass window, like William Golding (who was an undergraduate in science before switching to literature and wished that he knew more German) describing his chance meeting with Einstein on a bridge, bring Einstein in Oxford to life. Recommended for those who are interested in more detail on this aspect of Einstein's life, with only a cursory discussion of his science. — Phillip Helbig.

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A Crack in Everything: How Black Holes Came in from the Cold and Took Cosmic Centre Stage, by Marcus Chown (Head of Zeus), 2024. Pp. 350, 20 × 13 cm. Price £12·99 (paperback; ISBN 978 1 80454 433 4).

The late, great Leonard Cohen isn't mentioned directly (nor, as far as I can tell, indirectly) in the book, so I don't know if the title is intended as an allusion ("There is a crack in everything. That's how the light gets in") or is just an illusion. In any case, this book by former Caltech radio astronomer and prolific popular-science writer Marcus Chown is one of a large number of books on black holes, some of which I've reviewed in these pages. Although there is often little overlap between those which I had already read, I asked

*The one on p. 62 contains a sentence starting with "Then in spite of his scientific position he is a poor man", perhaps the first time I have seen 'then' used where today one would use 'for', though the usage was clear due to it being cognate with the German '*denn*', which is used only in that sense. ('Then' in the sense of 'after' is '*dann*'.)

myself whether another book is still needed. The answer is yes. While this book covers relatively standard topics, there is much more emphasis on the scientists involved, often based on interviews (some by the author himself). Many of the topics will be obvious just from the names: Schwarzschild, Chandrasekhar, and Kerr occupy the first three chapters. The fourth concerns Cygnus X-1 (the first black hole detected, by Paul Murdin and Louise Webster) while the fifth takes in several related topics: the discovery of quasars by Schmidt (not neglecting the roles played by colleagues such as Sandage, Oke, and Greenstein), the early efforts of Jansky and Reber, and AGN in general. Although most have heard of Ghez and Genzel in the context of supermassive black holes (SMBH), the corresponding chapter here, before telling their stories, goes into some detail on what came before, a story involving several people working independently or in groups. Once it was clear that supermassive black holes exist, it made sense to try to detect them, with gravitational waves and *via* the *Event Horizon Telescope* (*EHT*); in each case, such detection was possible only *via* a very large collaboration. Primarily observational so far, the ninth chapter delves into the mathematical theory of black holes and modern topics such as holography, the black-hole information paradox, and AdS/CFT correspondence*, but also the formation of the first stars, galaxies, and black holes. The final chapter is a summary of the others except 7 and 8 (gravitational waves and the *EHT*) and also asks whether the Weak Anthropic Principle could explain the relatively low mass of the SMBH in the Milky Way.

Although in all the chapters the scientists feature more strongly than in most books on the topic, they feature more strongly in the earlier chapters than in the later ones (the chapters are more or less in chronological order). Chown not only gets right what some authors got wrong (*e.g.*, Schwarzschild did serve (voluntarily) in World War I but, although he did think about General Relativity then, he did not die in the trenches, but rather after being discharged due to contracting *Pemphigus vulgaris*), but also provides information not easily found elsewhere (*e.g.*, Schwarzschild served not only on the eastern front (which is often mentioned), but also on the western front, and it was in Mulhouse in Alsace (modern north-eastern France) where he first became ill and also from where he corresponded with Einstein).

There are about the usual number of typos and (in my view) questionable style choices as well as a few minor careless errors, but on the whole the book is well written. All the same, Bethe is referred to as an American in the context of work done in 1938, which might be acceptable considering that he arrived there in 1935.† However, Lense, Thirring, and Boltzmann were by any sensible definition Austrian, not German. There are no figures; a few footnotes provide supplementary information; 'endnotes' are references cited in the text; there is a 16-page small-print index.

* Recycling a footnote from an earlier review: AdS/CFT correspondence refers to a popular (more than twenty thousand citations to Maldacena's original paper[1]) conjecture concerning the duality between anti-de Sitter spaces as used in some quantum-gravity theories and conformal field theories which describe elementary particles.

† Nationality is perhaps not well defined in the case of people who live in a country other than that in which they were born, whether or not that is voluntarily and whether or not there is any change in citizenship status, a point made several years ago by Simon Rattle when conducting the Berlin Philharmonic, introducing a piece by the *English* composer Handel (who did become a naturalized British subject in 1727). (In 2021, Rattle became a German citizen in order to be able to work more easily in the EU after Brexit.)

Not only does the book concentrate more on the scientists than do similar books, it also goes beyond the usual familiar narratives, giving credit where it is due and providing more background, and should be valuable to anyone interested in an accurate but non-technical history of astrophysical black holes. — PHILLIP HELBIG.

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The Beauty of Falling: A Life in Pursuit of Gravity, by Claudia de Rham (Princeton University Press), 2024. Pp. 231, 22·5 × 14·5 cm. Price £49·99/$64·99 (hardbound; ISBN 978 0 691 23749 7).

In this book, Swiss-born Claudia de Rham, now a professor at Imperial College, mixes descriptions of her work on gravitation with that of her (initially very successful but ultimately failed) quest to become an astronaut as well as those of other details of her life (*e.g.*, her childhood in several countries, learning her native language French from a Swedish mother in Peru, managing two careers in gravitational physics with her husband Andrew Tolley and their three daughters). The personal details are strewn throughout the book, which is best described as an introduction to the physics of gravitation together with a summary of modern developments, in particular those in which she has been involved (especially massive gravity). Seven chapters cover Special Relativity and the equivalence principle; curvature; tides and gravitational waves; singularities (after more details on her quest to become an astronaut, foiled by a positive test for latent tuberculosis, probably from her time in Madagascar); dark matter, dark energy, vacuum energy, and the cosmological-constant problem; massive gravity (*i.e.*, a theory in which the graviton has a non-zero rest mass); and (possible) tests of massive gravity; a short concluding chapter ends the main part of the book, followed by a two-page bibliography (mostly technical papers) and an eleven-page index, both in small print. There are a few black-and-white diagrams and photos scattered throughout the book (including one of the Einstein equation as graffiti on an abandoned locomotive in Bolivia) and fortunately footnotes rather than endnotes.

Of the many books I've read on General Relativity (GR), this is probably the best non-technical description (there are only very few equations, usually not part of the main narrative) — as simple as possible, but not simpler*. That is partly because she isn't attempting too much, but rather concentrating on aspects which lead up to her own work; it is also because she does a very good job describing a rather technical topic. (Qualitative analogies are always misleading at some level, but she emphasizes the weaknesses of some common qualitative descriptions of GR without finding them totally worthless.) The description of her own work on massive gravity bridges the gap between purely qualitative descriptions and the technical literature; we meet ghosts, extra dimensions, and types of gravitational-wave polarization which don't exist in unmodified GR. However, a common mistake is repeated, namely that Eratosthenes

*A saying attributed to Einstein, who at least said something similar.[1]

demonstrated that the Earth is round. (In fact, his method of measuring the circumference of the Earth requires two assumptions: that the Earth is round and that the Sun is far enough away for its light to be considered parallel. An observer on a flat Earth would see a nearby Sun at a different height above the horizon at noon depending on 'latitude'.) Some order-of-magnitude estimates appear to be wrong probably due to typos or bad editing, but I can't figure out how she could conclude that two astronauts initially one metre apart would, due to their mutual gravitational attraction, be moving as fast as garden snails after only a few milliseconds. (The point was to demonstrate the weakness of gravity; fortunately it is so weak that overestimating it by several orders of magnitude still results in a relatively weak force.) It would have been nice to know why she thinks that the Universe is probably infinite.

Despite my minor quibbles this book was a very enjoyable read and for some could be a good first book on GR, giving not only a broad overview but also highlighting current work in the field and, *via* both unsolved puzzles and the author's own enthusiasm, explaining the beauty of falling for gravity. — Phillip Helbig.

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Space Oddities: The Mysterious Anomalies Challenging Our Understanding of the Universe, by Harry Cliff (Picador), 2024. Pp. 285, 19·5 × 13 cm. Price £10·99 (paperback; ISBN 978 1 5290 9288 2).

Harry Cliff is a particle physicist at the University of Cambridge working on the *LHCb* experiment at CERN. This is his second popular-science book, and his interest in outreach also led to a joint post between Cambridge and the Science Museum in London (2012–2018).

Although David Bowie is not mentioned in the book, the title is an obvious nod to one of his songs. However, not all of the oddities concern space (*i.e.*, astrophysics); there are also chapters on anomalies in particle physics as well as in the overlapping field of astroparticle physics. The book begins with a quote from my childhood hero Isaac Asimov: "The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka' (I found it!) but 'That's funny...'." Or, as Robert Pirsig put it, "The TV scientist who mutters sadly, 'The experiment is a failure; we have failed to achieve what we had hoped for', is suffering mainly from a bad scriptwriter."[1] After a prologue discussing anomalies in general *via* some specific examples — explored in more detail later — and the first chapter on the standard model of cosmology, Cliff takes us on a tour of about a dozen anomalies, starting with two, the anomalous precession of the perihelion of Mercury and the Lamb shift, the resolution of both of which turned out to be new physics (resolution (*a*)). If theory and experiment disagree, there are three possible explanations other than new physics: a mistake in the experiment (*b*), a mistake in the theoretical prediction (*e.g.*, a mathematical error or failing to take a significant effect into account) (*c*), or a statistical fluke (*d*).

The third chapter discusses, in addition to some background on statistics, two claimed detections which do not point to new physics: the *BICEP2* debacle (which was very bizarre but more or less falls into (*c*), though not for the usual reasons) and the *DAMA/LIBRA* experiment (for the direct detection of dark-matter particles in an underground laboratory), which presumably falls into (*b*) because other experiments, including one designed to match *DAMA/LIBRA* closely, have failed to confirm the result. We then move to the story of Linda Cremonisi and *ANITA*, which is a detector mounted on a balloon above Antarctica the purpose of which is to detect radio waves from neutrinos impacting the ice below. *ANITA* can also detect cosmic rays, and the anomaly is one which seems to have travelled through the Earth to emerge from the Antarctic ice. Here, the resolution is not yet clear, but since the *IceCube* detector (photomultipliers in holes drilled into the Antarctic ice) hasn't corroborated the findings, it looks unlikely to indicate new physics.

The unexpected value of the magnetic moment of the muon is an anomaly of which perhaps many have heard. At first, the results from the measurement of the *Muon g-2* experiment increased the discrepancy between theory and experiment. The jury is still out, but there are indications that (*c*) could be the answer here, with more precise calculations involving hadronic vacuum polarization bringing theory in line with experiment. Like the previous chapter on *ANITA*, this one has many details of the day-to-day life of those doing such experiments. The story of neutrino oscillations being the answer to the solar-neutrino problem is perhaps the most recent example of new physics beyond what was then the standard model of particle physics.* That neutrino problem is solved, but another discrepancy between theory and experiment remains unsolved; the rest of the chapter discusses work by Bonnie Fleming and Chris Polly (who was also involved in the *Muon g-2* experiment), again a mixture theory, experiment, and the people involved.

The longest chapter, describing the author's own work, involves anomalies regarding the decay of B-quarks into muons. The resolution here is (*d*). While such a resolution is easy to effect in principle (just get more data), in practice it can consume the careers of several people. It's nice to have a detailed description of an anomaly which went away for a non-dramatic reason, as history tends to concentrate on the spectacular successes (and spectacular failures such as *BICEP2*). Somewhat more familiar to readers of this *Magazine* is the Hubble tension†, the discrepancy between different measurements of H_0, the value of the Hubble constant today, mostly between the value measured *via* 'local' sources such as type-Ia supernovae and the value predicted from the CMB. (The CMB doesn't measure the Hubble constant 'directly'; it is a derived parameter. However, that it can be measured at all involves assuming some cosmological model and calculating what the value should be today based on what is observed at the time of last scattering.) Some who remember when the debate was between values of 50 and 100, as opposed to 67 and 73, though with relatively smaller (claimed) error bars in the latter case (roughly, 1 per cent as opposed to 10 per cent), assume that the current Hubble tension will just go

*Although the mystery wasn't cleared up until 2001 when the results from the *Solar Neutrino Observatory* confirmed indications from *Super-Kamiokande* that the missing electron neutrinos had turned into mu and tau neutrinos (resulting in the PIs of those experiments, Arthur McDonald and Takaaki Kajita, receiving the 2015 Nobel Prize in Physics), in 1994 I had asked John Bahcall (who spent a large portion of his very prolific life on the solar-neutrino problem) at a conference whether he thought the resolution would be a problem with the experiments (*b*) or a mistake in theory such as inaccurate models of the Sun (*c*); he was confident even then that the answer would be new physics (*a*).

†Expect a review of an entire book about the Hubble tension in the next issue[2].

away, like many other anomalies. However, there are important differences. Fifty years ago, the value depended more on the astronomers than on the method, while these days it seems that the difference is due to the method (though of course different groups of people are experts on each method). My own impression is that all involved have also investigated the matter more closely, both their own work and that of those working on the other method. (There is also some tension between various groups working on 'local' methods; Chapter 8 highlights Adam Riess working with type-Ia supernovae (which he also used to measure the acceleration of the Universe, receiving a quarter of the 2011 Nobel Prize in Physics) and Wendy Freedman using the tip of the red-giant branch as standard(izable) candles.) Due to the large amount of data available and the fact that the tension seems to be increasing with time, (*d*) is probably not an option. If (*a*) is an option, that would indicate that something is wrong with the standard model of cosmology, in particular CMB physics. To me, though, that sounds unlikely, as that is well tested in other ways. With multiple observations, (*b*) doesn't look very likely either, though that might be the answer to the tension between various 'local' methods. Option (*c*) is a non-starter because there is no theory which can predict the brightness of standard(izable) candles to sufficient accuracy; those that are used are calibrated. The jury is still out on this one. (My best guess is (*c*) in the sense that a more realistic theoretical model could solve the problem, namely that our local part of the Universe is relatively under-dense. That doesn't seem to be a very popular idea, perhaps because it contains no new physics.)

The last of the main chapters introduces the σ_8 tension, though that rather technical term is not used. Basically, some measurements, especially those using the slight distortions of background galaxies due to weak gravitational lensing by foreground matter, indicate that the Universe is less clustered than one might expect from theory or indeed from other observations. (Actually, weak lensing measures a somewhat degenerate combination of the clumpiness parameter σ_8 and the density parameter Ω, so one could also say that the value of Ω from lensing is too low and σ_8 as expected. However, other constraints on Ω are stronger than those on σ_8.) It's unclear what the resolution will be. Since lensing is sensitive to all matter, not just that which is visible, perhaps luminous matter is more clumped relative to dark matter than in the standard model (in which, however, luminous matter is already more clustered than dark matter, a phenomenon going by the name of bias). This chapter ends with the discussion of the BOAT: the Brightest Of All Time gamma-ray burst. The short summary chapter starts off with a brief description of perhaps the most productive anomaly of all time, 'A Measurement of Excess Antenna Temperature at 4080 Mc/s'[3] and concludes with the author's look back on anomalies in physics, not just those mentioned in the book.

After a couple of pages of acknowledgements, the book ends with three pages of 'Notes', which are sources for information in the text, listing the corresponding page. They are not cited in the text, though. There are no figures, no index, and just a few footnotes. I didn't notice any serious mistakes and the number of typos and so on is somewhat less than is usually the case for similar books. (I did chuckle a bit after wrongly parsing a sentence: "A few weeks later, I flew to CERN for the first time after the pandemic had begun to present our results to the outside world.") I really enjoyed reading this book, which takes a somewhat different approach than most popular-science books *via* the scarlet thread of anomalies rather than being about some more or less clearly defined topic. Although of course all the anomalies are documented elsewhere, it's nice to have some of them (there are more, such as the puzzle of different methods to measure the half-life of the neutron giving different values) collected together and presented in a lively manner by someone involved in one of them, already knowledgeable about some others, and having well researched those outside of his field. — Phillip Helbig.

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From the Library

A Fire on the Moon, by Norman Mailer (Penguin Classics), 2014 (originally published 1970 by Little, Brown and Company). Pp. 421 (including 8-page introduction by Geoff Dyer), 20 × 13 cm. Price £10·99 (paperback; ISBN 978 0 141 39496 1).

Yes, *that* Norman Mailer (1923–2007), the great American novelist (by whom I've read one other book[1]). With a degree in aeronautical engineering (Harvard, 1943) and already a reputation as both journalist and novelist, Mailer was certainly qualified to write about the *Apollo 11* mission. The book (finished when *Apollo 13* was returning to Earth) is an expanded version of a three-part series in *Life* magazine, for which Mailer was paid somewhat less than $450 000 ("this ... figure, while certainly too generous, was not vastly inaccurate"). By contrast, in 1969, Armstrong, as a civilian, was paid an annual salary of $27 401, Aldrin and Collins (both Air Force officers) $18 623 and $17 148, respectively (multiply by a factor of 8 or 9 for the modern equivalents). As expected, the book is well written, sometimes reminding me of Dickens, Whitman, or Ginsberg. Mailer (who refers to himself as Aquarius) appears as a character in the book, much of which is in the New Journalism style.

Taking the number of pages and the small size of the print into account, there is very much information in the 15 chapters (grouped into three parts): technical information about the space programme, comments on the social and political situation at the time, long quotations from the radio communications between the astronauts and Mission Control, the geography and hotels of Florida and Texas, contemporary news coverage, and so on, all written essentially as the story unfolded. The first part sets the stage with a broad-brush overview and contains more on Mailer's own perceptions and activities; the second (making up about half of the book) is a detailed chronological account from lift-off to the docking of *Eagle* and *Columbia* after ascent from the Moon; the third (and shortest) includes the splashdown and related events but is more concerned with Mailer's philosophical reflections on the event. Mailer tells the story like a modern myth, except that it really happened. As one of the most significant events of the 20th (or perhaps any) Century, much has been written about *Apollo 11*, both from a technical and from a sociopolitical point of view. Mailer manages to cover both areas seamlessly, and is equally at home whether writing about how liquid oxygen is cooled and transported or about contemporary politics (also in 1969, Mailer finished fourth of five in the Democratic primary for mayor of New York City). As mentioned in another review[2], though I was young at the time I have many clear memories of the Apollo programme, which jibe well with Mailer's much more detailed account. (I noticed only a couple of minor mistakes, almost certainly essentially just typos.)

Already at the time, there were suggestions that the Moon landing was fake, and Mailer debunks them. There are other prescient inklings of what was to become the future: "[c]omputers the size of a package of cigarettes"; the rather quick loss of interest in even such a substantial feat, with "[T]he horror of the Twentieth century [being] the size of each new event, and the paucity of its reverberation". Although many aspects of the book are impressive, perhaps the most impressive is the scope, from the Greek myths through the *Star Trek*-style technical optimism of the 1960s to the different ways (then) future (and now current) society would look back on such a monumental event. The book is not just historical but might prove to be historic, a rare first-hand account of history in the making where the witness understands both the nitty-gritty details and the vast sweep of human history of which it is a part. — PHILLIP HELBIG.

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ASTRONOMICAL CENTENARIES FOR 2026

Compiled by Kenelm England

The following is a list of astronomical events whose centenaries fall in 2026. Births and deaths of individual astronomers are taken from *Biographical Encyclopedia of Astronomers* (2nd ed., Springer, 2014). This was supplemented by the on-line Obituary Notes of Astronomers and Obituary Lists of RAS Fellows and other societies. For events before 1600 the main source has been Barry Hetherington's *A Chronicle of Pre-Telescopic Astronomy* (Wiley, 1996). For the 17th to 20th Centuries lists of astronomical events came from Wikipedia and other on-line sources, supplemented by astronomical texts made available through the NASA Astrophysics Data System. Discoveries of comets, asteroids, novae, and other objects for 1926 appeared in the February issue of *Monthly Notices of the Royal Astronomical Society* in the following year. There were also references from *Popular Astronomy*, *Journal of the British Astronomical Association*, and *Publications of the Astronomical Society of the Pacific*. Professional discoveries and observations were followed up in *Philosophical Transactions of the Royal Society of London*, *Astronomische Nachrichten*, *Astronomical Journal*, and *Monthly Notices of the Royal Astronomical Society*. Gary Kronk's *Cometography* Volumes 1–3 (Cambridge, 1999–2007) provided details on all the comets. Details on meteorites can be found in the Meteoritical Society's Bulletin Database. Finally, NASA's *Five Millennium Canons of Eclipses* and planetary tables were consulted for information on eclipses and planetary events.