Archimedes. Fulcrum of Science, by Nicholas Nicastro (Reaktion), 2024. Pp. 191, 22·5 × 14·5 cm. Price £15·99 (hardbound; ISBN 978 1 78914 922 7).

This biography of Archimedes of Syracuse (modern Siracusa, Sicily), the greatest mathematician in the ancient world, is a fine example of modern historiography. Its accounts of context, circumstance, and consequence combine to portray such a vivid tableau that you can imagine you're standing in the shadow of this remarkable polymath: engineer, inventor of engines of war, and pioneer of geometry. Over 1800 years elapsed before the next great mathematician walked on the stage, Isaac Newton, who praised Archimedes as one of the giants on whose shoulders he had stood. Historians have only meagre sources on the life of Archimedes. In his *Life of Marcellus*, Plutarch documents the defensive devices that Archimedes deployed while protecting Syracuse against the Romans' assault from the sea. Plutarch also lamented the death of Archimedes, killed by a Roman soldier. In one version of the story Plutarch adds celestial colour by noting that Archimedes was carrying mathematical instruments such as sundials, spheres, and quadrants. Recent scholarship adds the name of Archimedes to the story of the Antikythera Mechanism, an ancient analogue device recovered in 1901 from a shipwreck that allowed the user to simulate the motions of the Sun, Moon, and the five planets known to the ancients. With the expected restraint of an accomplished historian, Nicholas Nicastro airs the notion that "Archimedes' work on sphere-making *inspired* the calculating devices that followed."

What impressed me most about this title is the delightful manner in which it rises above familiar and well-worn recitals of myths, legends, and traditions by focussing on what we really do know about everyday life and the academic pursuit of knowledge in Syracuse in the third century BCE. The author offers a pretty good example of an accessible public history rather than a dull chronicle. Read and enjoy! — Simon Mitton.

Black Holes: The Key to Understanding the Universe, by Brian Cox and Jeff Forshaw (William Collins), 2023 (originally published 2022). Pp. 288, 19·7 × 13 cm. Price £19·99 (paperback; ISBN 978 0 00 839064 8).

There are of course many popular-science books on black holes, at a variety of levels and with a variety of emphases, such as the book I read just before this one[1,2]. However, the two books are very different. This book is about the mathematical theory of black holes. There is little material on astrophysics and that is only to understand the formation of astrophysical black holes. Both authors are professors of theoretical particle physics at the University of Manchester; Cox is well known as a popularizer and is also the Royal Society Professor for Public Engagement in Science. Those who take the trouble to understand a topic outside of their own field are usually good at explaining it, as I've noticed in other books (*e.g.*, refs. 3,4); that is certainly the case here. While there are only a few equations, there are several diagrams, many of them Penrose diagrams. This is the book if you want a thorough, correct, yet mostly non-mathematical introduction to Kruskal–Szekeres coordinates and want to have fun in the process.

After a brief history of black holes, the necessary background is built up piece by piece: Special Relativity, General Relativity (GR), Penrose diagrams, curvature, the interior of black holes, white holes and wormholes, and rotating (Kerr) black holes. Only after that do we meet collapsing stars, and then mainly to understand where many black holes come from. After that, the emphasis

shifts to topics of current research: black-hole thermodynamics; Hawking radiation; the fate of objects before, during, and after crossing the event horizon; quantum entanglement; the holographic principle; AdS/CFT correspondence; and the connection between the previous two topics and quantum information. All are rather technical topics in the mathematical theory of black holes, yet the descriptions are both correct and easy to understand, with little mathematics. As such, this book is a very good introduction to those like myself who like a 'physics first' approach to GR: first understand the concepts then learn as much maths as necessary to work with them. While the entire book is good, I made a note of the fact that the chapters on white holes, wormholes, and Kerr black holes are particularly good. The only mistake I noticed is the old canard that John Wheeler coined the term 'black hole' (something Smethurst[1] gets right and which she discusses in some detail).

As almost always I notice a few matters of style which depart from my own preferences, but less so than in most books. There are many black-and-white figures, mostly space–time diagrams, scattered throughout the book, some of which also exist on the sixteen traditional glossy colour plates at the middle of the book. The four pages of endnotes are references to the technical literature (footnotes are proper footnotes). An eight-page small-print index ends the book. This is the best non-technical detailed introduction to the mathematical theory of black holes, a judgement which would probably stand even if there were others.

Recommended. — Phillip Helbig.

References

(1) B. Smethurst, *A Brief History of Black Holes: And Why Nearly Everything You Thought You Know About Them is Wrong* (Pan Books), 2023.
(2) P. Helbig, *The Observatory*, **145**, 125, 2025.
(3) W. D. Heacox, *The Expanding Universe: A Primer on Relativistic Cosmology* (Cambridge University Press), 2015.
(4) P. Helbig, *The Observatory*, **136**, 204, 2016.

Other Books Received

The Physics of Supernovae and Their Mathematical Models, by Alexey G. Aksenov & Valery M. Chechetkin (World Scientific), 2024. Pp. 279, 23·5 × 16 cm. Price £100 (hardbound; ISBN 978 981 12 8509 7).

A theoretical, and highly mathematical, monograph on supernovae, covering basic principles, numerical methods, and applications.

Introduction to Supergravity and Its Applications, by Horatiu Nastase (Cambridge University Press), 2024. Pp. 426, 26 × 18·5 cm. Price £64·99/$84·99 (hardbound; ISBN 978 1 009 44559 7).

Aimed at PhD students, this volume covers the basic formalism of supergravity suitable for a focussed first course.