find out which components of Model T Fords had failed. On being told that the kingpins never failed and had years of service left in them, Ford immediately gave orders to make Model T kingpins to a lower specification. I also liked Barrow's imagined conversation between Einstein and a porter at Paddington station 'Does Oxford stop at this train?' As to arcane facts, there are many examples to choose from. These range from large numbers—such as the fact that a Petagram (10^{15} gm) is about the mass of a large mountain and that insects contribute about 30 Petagrams to the living material on the Earth—to the very small—such as the fact that quantum uncertainty renders our knowledge of Newton's laws of mechanics useless for predicting the location of a billiard ball after only ten successive collisions with other balls and the sides of the table. It is important to emphasize that the incorporation of such 'popular material' does not detract from Barrow's discussions of serious scientific problems. I believe that inclusion of such 'hooks' is essential for popular accounts of complex scientific topics to retain the interest of non-scientists. One of the most celebrated popularizers of science was Richard Feynman. In his unusual acceptance speech for his 1964 Nobel Prize, Feynman states explicitly that he has deliberately included 'non-scientific' anecdotes and jokes in order to keep his audience interested. John Barrow uses similar devices in these essays and this collection makes clear why he has become one of the foremost exponents of scientific popularisation.

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Electrodynamics
By F. Melia

Chicago University Press. In the series: Chicago Lectures in Physics, 2001, US$15.00 (pbk), US$35.00 (hbk), pp. x + 251, ISBN 0 226 51958 9 (pbk), 0 226 51957 0 (hbk). Scope: Text Notes. Level: Postgraduate.

Lord Kelvin is reported as instructing that one should "not imagine that mathematics is hard and crabbed, and repulsive to common sense. It is merely the etherialization of common sense." If this is true, then Melia's book on Electrodynamics is full of common sense etherialized. This is a graduate text which covers some notoriously "hard and crabbed" parts of electromagnetism, including time-dependent Green's functions, radiation from antennae and the Maxwell stress tensor. However the concepts are so well explained that the clarity and elegance of the theory shines through. Classical electrodynamics describes how fields behave (Maxwell's equations) and how charges respond to those fields (the Lorentz force). These two processes are connected so that electromagnetic waves can be created and sustained in space. However to produce equations which transform properly, relativistic electrodynamics is needed and a phenomenon such as synchrotron radiation (important in condensed matter physics, particle physics and astrophysics) requires that relativistic effects are properly included. This book describes the intellectual journey from classical electrodynamics to a relativistic Lagrangian formalism, and therefore takes the reader from undergraduate electromagnetism to the concepts of field theoretic treatments.

This could be an arduous journey, but fortunately the style of the book is consistently helpful. For example, the concept of a residue in complex variable theory is succinctly but clearly reviewed before a particular Green's function is derived. Helping the reader to sharpen up a half-remembered concept before using it performs a great service. Even at the beginning of the book, Maxwell's equations are carefully introduced one by one and the author takes time to explain the mathematical background (including elliptic, parabolic and hyperbolic forms of differential equations), gently making contact with gauge theories and applications to supersymmetry.

The concept of Lagrangians and Noether's theorem are beautifully done, and the introduction of special relativity is clearly set out. I particularly liked an example of a Maxwell stress tensor being used to arrive at the same result that can be obtained using the method of images. It was nice to see a piece of heavy electromagnetism machinery, which is usually kept for special occasions, being used to make contact with something with which I was extremely familiar. This careful treatment ensures that the book bridges the gap between simple electromagnetism texts and more advanced field theoretic treatments. Also the description of Bremsstrahlung and radiation damping was helpfully summarised.

The book concludes with some 'special topics' which are all essentially astrophysical applications, including synchrotron emission, superluminal sources and black holes at the galactic centre. These were all treated rather briefly and it might have been nice to see how electrodynamics applies to other branches of physics.

There is no mention in this book about the choice of units used, but in fact the whole work is entirely set out in cgs units. This is unfortunate since most of the potential readership of this book will have been schooled in the SI system. The gains in clarity of explanation are thus partially outweighed by the extra factors of 4π and c littered about which will inevitably confuse students attempting to master this subject. There is not even a table in which the necessary conversions are listed. Since this book is so good at the details, it is a great shame that this was missed. Nevertheless, this book is to be recommended as a clear and

entertaining exposition of some difficult, beautiful and important concepts in physics.

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Fundamentals of Equations of State
By Y. ELIEZER, A. GHATAK and H. HORA

World Scientific. 2002, £49.00(hbk), pp. xviii + 366, ISBN 981 02 4833 4. Scope: Text. Level: Advanced undergraduate and Postgraduate.

To many physicists, "equation of state" conjures up memories of Van der Waals' equation and not very much else. They will be startled to realise that the term is of course equally applicable to quite different equations describing Bose-Einstein and Fermi-Dirac assemblies, white dwarf and neutron stars, supernovae, plasma and nuclear matter. In fact, the equation of state (EOS) describes any physical system by the relation between its thermodynamic properties e.g. pressure, volume and temperature. The EOS thus provides a universal way of considering Nature under all possible conditions, just provided that local thermodynamic equilibrium can be maintained. The concept is applicable even under very extreme conditions, leading to interdisciplinary studies and applications in e.g. high pressure physics, geophysics, astrophysics, and plasma physics.

Studies of the EOS should therefore be seen as of fundamental importance in physics, which is what provides the justification for reprinting Eliezer *et al*'s interesting book. It is an ambitious work, seeking to cover the subject in 366 pages. After an introductory chapter to set the scene, the authors summarise classical thermodynamics and statistical mechanics in just 8 pages, providing the essential basis for much that follows. The next 14 chapters treat matter in all its variety, including ideal gases, vibration and rotation in molecular gases, Bose-Einstein condensation, the Fermi-Dirac EOS (both non-relativistic and relativistic), ionization and the Saha equation, the Debye Hückel equation, the Thomas-Fermi and related models, the Grüneissen EOS, fluid mechanics, shock waves, the EOS for thermonuclear fusion under inertial confinement, the EOS in astrophysics (extensively, in 44 pages), and the EOS in elementary particle physics. There is a thoughtful Forword by Edward Teller, and 8 appendices treating topics such as the density of states for a particle in a box, and the derivation of Stirling's formula. A list of references is provided at the end, grouped by chapter.

The book was originally published by Cambridge University Press in 1986 with a slightly different title. The present version published by World Scientific seems to be a straight reprint, with the text unchanged apart from a new Preface. In the latter, the authors refer to some of the many new results reported since 1986, and argue that

> "... the unchanged text of the original publication ... may be of even greater relevance now for advanced lecturing and for important new research and applications."

It takes either courage, or laziness, to reprint a book after a gap of 16 years, without updating anything. In the present case, I feel that it is the former quality that applies, as this is one of those books that seems almost timeless in its relevance and applicability. Quite possibly, it can be reprinted again in 2018 without change, or with only very minor ones e.g. extensions of the applications and to the corresponding references.

The readers of the book should include all physicists who take a broad view of their subject and do not confine themselves just to narrow specialisms. The EOS is one of those unifying concepts that is applicable across almost all of physics, and beyond it to chemistry, materials science and engineering. The book is probably not recommended reading for many particular lecture courses but, because it provides a cross-cut through the traditional packaging of the subject, it has someting useful for almost all courses and levels of presentation beyond 2nd year undergraduate, not least because it provides such a nice demonstration of the essential unity of physics.

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Gravitational Solitons
By V. BELINSKI and E. VERDAGUE

Cambridge University Press. In the series: Cambridge Monographs on Mathematical Physics, 2001, £60.00 UK$90.00 (hbk), pp. xii + 258, ISBN 0 521 80586 4. Scope: Monograph. Level: Specialist.

There are at least two ways in which the words "*Gravitational Solitons*" may be understood

(i) localisable lumps of energy and mass, possibly stabilised by a conserved and sometimes topological charge
(ii) Integrable solutions of a 1 + 1 dimensional system of P.D.E.'s equivalent to Einstein's equations for the metric of a four-dimensional spacetime

It is the second sense which is being used in the title of this book. To arrive at the P.D.E's from a 4-dimensional