abstract index notation rather than traditional tensor notation. The formal treatment of manifolds, differential forms, continuous transformation groups, conformal transformations and the Hamiltonian formulation are all contained in extensive appendices that are designed to be integral parts of the text, displaced from the main body only on the grounds of continuity.

The first portion of the book covers the traditional ground from special relativity to Einstein's equations in a mathematical manner that I found was slightly lacking in its discussion of the physical motivation and content of the formalism; perhaps it is assumed that the reader has already followed a traditional introductory course? However, the outstanding part of this book is the treatment of a wide range of advanced topics in the second half of the text. Modern techniques for generating and classifying exact solutions to Einstein's equations, the causal structure of space-time and the use of techniques from differential topology to prove singularity theorems are all developed in detail. Each chapter is followed by a number of problems, although solutions are not supplied. The final series of chapters provides modern discussions of the initial value problem and Penrose's conformal treatment of infinity. These later chapters also focus upon topics close to the author's own research interests and there is a particularly nice introduction to developments in quantum gravity and the study of quantum fields in a classical curved space-time as well as detailed discussion of black hole mechanics and thermodynamics.

This is a much-needed book that will greatly stimulate the teaching of advanced graduate courses in modern gravitation physics. It will also provide an invaluable directory of modern techniques and results for gravitation theorists. □

John D. Barrow is a Lecturer in Astronomy at the University of Sussex.

Physical reasoning

Colin Upstill

Theoretical Concepts in Physics.
By M.S. Longair.
Cambridge University Press: 1984. Pp.366. Hbk £25, $49.50; pbk £8.95, $14.95.

IT IS the exception rather than the rule for brilliant scientists to be the best teachers: Planck studied under Helmholtz and Kirchoff, but confessed that "the lectures of these men netted me no perceptible gain". Most of us have at some time had the same experience, going full of expectation to a lecture by some professor of renown, only to find the lecture-room clock of more interest than his impenetrable phrases and even more impenetrable algebra.

Sadly, good textbooks are a rarity too. The texts whose content best matches our syllabuses are all too often hastily compiled pot-boilers, spin-offs from others' fumbling attempts at courses with similar titles to our own. It is of the greatest value in university teaching to possess a full and deep understanding of one's subject matter, yet to be aware of what it is like to be a student who does not. Professor Longair has this rare gift, and he has used it to good effect in writing this excellent book, subtitled *An Alternative View of Theoretical Reasoning in Physics for Final Year Undergraduates*. The subtitle hardly does the book justice; it is a complement rather than an alternative to most standard courses and standard texts — providing the cement of understanding to put between the blocks of lectures which go to build a physics course.

For most of the topics covered, Longair has leant heavily on the best treatments available elsewhere, and has often gone back to the original literature — for men such as Einstein, Maxwell and Rayleigh expressed lucidly ideas which subsequent generations of authors have muddled and obscured. It is no surprise to find that the book owes a great debt to Feynman's three-volume *Lectures on Physics* (Addison-Wesley, 1963–1965). But let me make it quite clear that Longair's book is much more than a collation of familiar material from diverse sources; throughout, it is stamped indelibly with the author's own deep insights and, equally important, his enthusiasm for his subject. This enthusiasm comes over vividly, and has resulted in a learned book with the rare property that it is compelling: like a well-crafted novel, it is hard to put down; at the end of each chapter, one turns the page eager to see what happens next. In my view, Longair has provided for final-year physics undergraduates the sort of essential background Feynman gives them in their first and second years. No facet of the reality of the practice of physics is omitted, from the importance of experimental observations for theory (via Kepler's use of Tycho Brahe's observations and especially his error analysis, which was so crucial to the discovery that the orbits of the planets must be elliptical rather than circular), through the use of models (such as Maxwell's mechanistic models for electromagnetic phenomena), to the use of computers (to simulate the synthesis of light elements in the hot big bang).

In his epilogue, Longair admits that in preparing the book he learned a great deal which he wished he had known years ago. I feel the same after reading it. □

Colin Upstill is a B.P. Venture Research Fellow at the H.H. Wills Physics Laboratory, University of Bristol.

Round the mechanics course

J.W. Humberston

Classical Mechanics*.
By B.P. Cowan.
Routledge & Kegan Paul: 1984. Pp.111. Pbk £3.95, $9.95.

CLASSICAL mechanics continues to be regarded as an essential component of a modern degree course in physics, and this book attempts to cover all the material required by a student taking a first course in the subject. It is a rather bold claim to make of a book containing only 111 pages, but the choice of topics is generally satisfactory. There are chapters on Newton's laws, energy and momentum, dynamics of a single particle, many-particle systems and rigid bodies, and non-inertial frames. The final chapter gives a very clear introduction to Lagrangian and Hamiltonian mechanics, ending with a brief section on Poisson brackets and their relationship to commutators in quantum mechanics. Worked examples are distributed throughout the book and a short set of problems (with solutions) is also included.

Because the book is so small, there are, inevitably, omissions. For me, the most serious of these relates to moments of inertia. After a brief account of the inertia tensor there is merely the statement that the diagonal elements are the moments of inertia. No mention is made of the motion of a rigid body about a fixed axis (unless it be a principal axis) nor of the theorems of parallel and perpendicular axes. There is not even a worked example of the calculation of a moment of inertia.

Also, in the discussion of motion under an inverse square law of force, insufficient detail is given of the properties of conic sections. It is assumed, I would have thought unreasonably, that the reader is already familiar with them. A bibliography of more extensive works in mechanics would have been some compensation for these and other omissions but, unfortunately, one is not provided.

The book is written in a clear and concise style and, despite its shortcomings, should generally be well received by its intended readership. □

J.W. Humberston is a Lecturer in the Department of Physics and Astronomy at University College London.

*A volume in Routledge & Kegan Paul's *Student Physics* series. Other titles to appear during 1984 were *Quantum Mechanics* (by Paul Davies), *Relativity Physics* (Roy Turner) and *Electricity and Magnetism* (Roland Dobbs). All are short paperbacks costing £3.95, $9.95. Forthcoming later this year are *Electromagnetic Waves* (Roland Dobbs) and *Liquids and Solids* (Michael Sprackling).