Methods for cool operators

Low Temperature Laboratory Techniques: The Use of Liquid Helium in the Laboratory. Second edition. By A. C. Rose-Innes. Pp. 255. (English Universitiies: London, 1973.) £3.95.

THIS is a new edition, brought up to date (although no references are later than 1971) and expanded with sections on developments since 1964. The main sections are concerned with the temperature range above 1 K, with coverage of the handling of helium, cryostats, and the design of apparatus, and the measurement and control of temperature. Towards the end are chapters on the use of ^{3}He (including dilution refrigeration, but not Pomeranchuk refrigeration) and on temperature measurement below 1 K.

The advice given is at an unusually detailed practical level, often to such an extent that every dimension and technique seems to carry a personal guarantee. The numerous figures reinforce this feeling by their directness and simplicity. I can see the value of this approach, particularly for the beginner who often has to take responsibility for the lowlier aspects of research without the author's experience. Inevitably, with such a laboratory–workbook format there are places where the reader may wish to add, remove or alter, but on the whole it is a useful collection of highly practical tips. The data tables are also helpful.

There are a number of unnecessary variations of notation (for example He^3 on p. 193; helium^3 on p. 194; ml on p. 22; cm^3 on p. 23); misprints (I enjoyed "owl temperature" on p. 99 and "aneroid" on p. 114 among others) and unnumbered equations. Generally, though, appearance and visual clarity are good.

D. S. Betts

Nuclear structure

Theoretical Nuclear Physics. Vol. 1: Nuclear Structure. By Amos de Shalit and Herman Feshbach. Pp. xxviii+979. (Wiley: New York and London, June 1974.) £14.60.

THE appearance of this volume is a notable event for nuclear physicists and yet another reminder of the loss to the scientific community caused by the untimely death of Amos de Shalit. It is the first of two volumes covering essentially the whole of nuclear physics; this one is devoted to nuclear structure and a forthcoming volume will cover nuclear reactions.

The authors aimed to cover all the important ideas as clearly as possible, and in a way that will inspire as well as instruct, and they have succeeded brilliantly. A brief summary of the contents will indicate the scope of this encyclopaedic work.

The first chapter is an introductory review of nuclear physics, dealing with nuclear sizes and masses, forces and energies, and also with nuclear systematics, regularities in nuclear spectra, electromagnetic properties of nuclei, high energy scattering and reactions and associated topics. Subsequent chapters are devoted to nuclear models, starting with the simplest that likens the nucleus to a Fermi gas. There are sections on the Weisäcker mass formula, one and two-particle densities, coulomb energies and the nucleon–nucleon force and nuclear stability. Next comes a chapter on nuclear matter, basic to the understanding of nuclear properties. The independent-particle and independent-pair approximations are described, together with the Bethe–Goldstone equation and its solution.

Two chapters are devoted to the independent particle and shell models. It is shown how the single-particle shell model with either an harmonic oscillator potential or a more realistic rounded and finite potential is able, provided a spin-orbit term is included, to account for many basic features of nuclear structure, in particular the magic numbers and the spins, parities and magnetic moments of nuclear states. The model works best for nuclei near closed shells, but it is also shown how it may be extended to nuclei with several particles outside closed shells, and its success is illustrated by examples. The Hartree–Fock self-consistent field theory is developed and applied to closed and open-shell nuclei. The method of classifying nuclear states with the help of the concept of isospin is described and illustrated by examples, using various coupling schemes. There are also sections on particle–hole configurations, fractional parentage coefficients and configuration mixing in many-particle systems.

Away from closed shells it becomes increasingly difficult to use the shell model to describe nuclear states because of the very large numbers of possible configurations, and for such nuclei the collective models are often more appropriate. In such models many nucleons are assumed to move together, either as a rotation or as a vibration of the whole nucleus. With an appropriate collective Hamiltonian it is possible to calculate many of the properties of such nuclei.

The theory of multinucleon systems is considered next, with a detailed account of the Hartree–Fock theory, the random phase approximation and the free quasi-particle system, all using