Bureau of Standards Laboratories", and are now called "Institutes for Environmental Research". This frequent change of name does not detract from the excellence of their work. The author has participated in lecture courses given there and is an experienced teacher who tries to explain the physical meaning of mathematical formulae. His book is intended both for graduate and undergraduate students and for professional engineers.

One longish chapter discusses the formation and movement of ionospheric layers, their interrelation with the Sun and the Earth's magnetic field and their diurnal, seasonal and geographic variations. The rest of the book deals almost entirely with the propagation of radio waves, and the problems discussed are those which can be handled by the methods of "ray theory" or "geometrical optics". There is no discussion of phase integral methods nor of W-K-B solutions, although some physicists would say that these topics should be included in ray theory. The Booker quartic equation is briefly mentioned but gets barely a page. But there are very thorough and clear discussions of such topics as dispersion, absorption, virtual height and ray paths. The approach is based, broadly, on that used by Lorentz and Appleton, but a more sophisticated kinetic treatment using the Boltzmann equation is explained in the chapter dealing with velocity dependence of the electron collision frequency. A chapter on topside sounding reviews the large amount of new ionospheric knowledge recently obtained from satellite borne instruments, and includes such topics as ducted echoes and plasma resonances. The final chapter, on non-linear processes, includes a brief account of wave interaction or cross modulation. The book amply fulfils its stated purpose of making the subject interesting to the engineer and leading the more advanced student on to further study.

K. G. BUDDEN

SIMPLIFIED SUPERCONDUCTIVITY

Introduction to Superconductivity

By A. C. Rose-Innes and E. H. Rhoderick. (International Series of Monographs on Solid State Physics, Vol. 6.) Pp. xvi + 228. (Pergamon: Oxford, London and New York, May 1969.) 70*s*; $9.50.

THE authors stress that this is an introductory text. It is more descriptive than mathematical and is very clearly written. Appropriately, the rationalized mks system is used.

The subject is developed in a conventional order. The first half of the book (eight chapters) is devoted to electrodynamics, using the London theory, and elementary thermodynamics. There follow two chapters on microscopic theory and tunnelling respectively, an excellent chapter on quantum interference (d.c. Josephson effect) and two chapters on type II superconductivity. The microscopic theory is not expounded but described, without second quantization, and the principal ideas of the theory are well presented.

It seems to me that there are advantages in treating type I and type II superconductors together from the outset: the discussion of surface energy gains content; the persistent currents in a type II superconductor are more interesting; and finally, of course, Essmann and Träuble's famous photograph[1] of the Abrikosov lattice, reproduced here as a frontispiece, leaves no doubt about fluxoid quantization. The authors must have considered weaving type II superconductivity into the main part of the text and it would be interesting to know why they rejected the idea.

A treatment at this level has to be simplified; in some places I find it oversimplified. It seems questionable that the Pippard equation is not mentioned. Some of the diagrams are sketches, when they might have been the real thing. To mention two examples, the figure showing variation of energy gap with temperature does not tally with published tables[2], and the current–voltage characteristic of a tunnel junction is merely sketched. The most serious weakness, however, is that the notion of coherence length is wrongly treated. The phrase is commonly used for two different things: the range of the Pippard kernel (ξ_P), and the fundamental distance of the Ginzburg–Landau theory (ξ_{GL}). ξ_P is independent of temperature, and is equal to l for short mean free path l. ξ_{GL} is temperature dependent, diverging at T_c, and for small l the zero temperature value is $(\xi_0 l)^{1/2}$ (ξ_0 = value in pure material). The authors generally mean ξ_{GL} (treatment of surface energy and of mixed state), but twice state the "dirty limit" value as l, and say nothing about the temperature dependence.

There is a dearth of introductory books on superconductivity and this book is to be welcomed for the general clarity of its exposition.

D. R. TILLEY

[1] Essmann, V., and Träuble, H., *Phys. Lett.*, **24A**, 526 (1967).
[2] Mühlschlegel, B., *Z. Phys.*, **155**, 313 (1959).

INTRODUCTION TO METALS

Elementary Science of Metals

By J. W. Martin. (The Wykeham Technological Series for Universities and Institutes of Technology.) Pp. xii + 133. (Wykeham: London and Winchester, 1969.) 20*s*.

THIS book is announced as the first of a "technological series" for universities and institutes of technology: it is surprising to find the science of metals classed as technology while industrial acoustics, for example, qualifies as a member of the publishers' parallel "science series", and one may wonder whether the distinction is a useful one. The book has, however, in common with others in both series, that its author is a university teacher who has had the assistance of a schoolmaster, in this case R. A. Hull of Uppingham School. The book will be useful for undergraduates at the start of a university course in the physical sciences, for students at the equivalent stage in colleges of technology and for those senior students in schools who may wish to break out of the confines of the maths–physics–chemistry combination.

An introduction is given to the greater part of the subject of physical metallurgy, with chapters on bonding and the crystal structures of metals, grain structure and metallographic techniques, alloy microstructures and phase diagrams, elastic and plastic deformation, strengthening mechanisms and fracture. Within 133 pages the coverage of these topics is necessarily elementary, but the book has been well planned and clearly written: treatments are seldom quantitative, but explanations are clear and interesting and well suited to a readership of beginners in the subject. A nice balance is held between a purely phenomenological and a purely theoretical approach. A pleasing feature is the inclusion of simple problems and practical experiments at the end of each chapter. The experiments are stimulating and require only the simplest, readily available equipment, and the author has remembered, for instance, to give instructions for adapting the more common biological microscope for metallographic work.

The book has good quality paper between cardboard covers and is amply illustrated. The quality of reproduction of the micrographs is adequate, but one must criticize the line diagrams which are in many cases very badly drawn. Although the diagrams often convey their message clearly enough, their poor quality gives an unnecessarily cheap appearance to an otherwise reasonably priced book. It is to be hoped that this very useful introduction will be widely used by embryonic scientists