output of scientific papers in free radical chemistry is already far too great for thorough comprehension by personal reading, specialist review volumes, though expensive, have become essential secondary sources of information for research workers. Monograph series, such as the Wiley-Interscience publications, of which this is but one volume, are thus necessary additions to the shelves of reference libraries.

Even the poorest specialist essay provides its readers with references that save days of working time in the preparation of a card index: a good essay in addition stimulates thought and the critical appreciation of the merits, failings and basic objectives of modern research papers. This collection of eleven essays on free radical reactions is a mixed bag in regard to both quality and intrinsic value. Each author has been allowed to present his own view of the scientific importance of his selected topic. Some (for example, J. W. Wilt, who contributes a mammoth chapter on free radical rearrangements) have chosen to write up a comprehensive card index, others present narrowly American viewpoints on small and highly specialized researches (for example, R. G. Bergman, who describes biradicals by detailed reference to trimethylene, and J. G. Garst of the University of Georgia, who discusses radical-anions mainly by reference to that of naphthalene), but the more experienced writers tabulate data and discuss critically their overall value. These chapters are of general interest because they show that few novel kinetic theories are now likely to emerge and that far too many of our published data are experimentally imprecise and often theoretically superficial.

This last comment applies particularly to the chapters by J. D. Kerr on rate constants in gas phase reactions, by K. U. Ingold on absolute rate constants in liquid phase reactions, by G. A. Russell on relative rate constants of radical reactions and to two short chapters by T. Koenig on some typical homolytic decompositions and on "cage effects" on decomposition rate in solution. J. K. Kochi presents kinetic researches much more descriptively. He deals with redox reactions of free radicals and metal complexes, covering the wide field of his own recent interests but including in some detail well known theories of metal ion catalyses of autoxidation and peroxide decomposition. A. G. Davies and B. P. Roberts, in a concise but stimulating chapter on bimolecular homolytic substitution at metal centres, extend widely the mechanistic outcome of their own work on the free radical chemistry of boron, phosphorus and sulphur. The outstanding new development in free radical chemistry is also described in a short chapter on chemically induced dynamic nuclear polarization (CIDNP) by H. R. Ward. This new physical technique for the diagnostic detection of free radical reactions has great potentialities particularly for the study of reaction mechanisms, but Ward has been quite cautious in his assessment.

The book as a whole shows that many aspects of free radical chemistry have now been developed so extensively that they are declining in academic but not industrial interest, though they still comprise the efforts of the majority of research workers in this field. However, some quite new themes and experimental techniques are emerging and these have quite properly been brought to our attention.

W. A. WATERS

Thermodynamics

An Introduction to Equilibrium Thermodynamics. By Bernard Morrill. Pp. xi+353. (Pergamon: Oxford and New York, February 1973.) £7.50.

I AM a chemist by training and was somewhat disconcerted, having accepted an invitation to review on title alone, to find that this volume is slanted towards American engineering students. Nevertheless, it is interesting to discover how others learn. The book's introduction suggests that the text is intended to "open up new areas of electrical engineering thought". I expected, therefore, a thermodynamic discussion on thermocouples and thermoelectric power, Peltier effects, Johnson noise, fuel cells, and so forth. None of these is mentioned and the most specialist treatment is reserved for steam engines, steam turbines and nozzles.

The main text covers a wide range of traditional thermodynamics, Carnot cycles, Gibbs functions, ideal gas mixtures and the like, which are at least as familiar to chemists as to engineers. The treatment takes the principles of the subject quite rapidly so that the third law and grand partition functions are completed by the end of chapter 2, to be followed by some more detailed work and the applications. The text is, in general, competent, clear and fairly mathematical. I improved my knowledge, especially from the section on Legendre transformations and from the treatment of throttles. But there is nothing exceptional for those content with their present texts.

There are problems, both worked and for the student. It is in the adoption of Imperial units that most is done to make the work especially suitable for engineers. I hope I shall never again meet the universal gas constant in the form 1545.3169 ft lbf/°R lbm mole.

D. H. WHIFFEN

Phonons

The Physics of Phonons. By J. A. Reissland. Pp. xi+319. (John Wiley: New York and London, April 1973.) £7.

THIS book is based upon an excellent idea: to present in one volume most of the aspects of phonon physics; and so it is even more restricted than Ziman's *Electrons and Phonons.* As a reference book for undergraduates, graduate students, as well as research workers, it presents a very convenient compendium. I would, however, hesitate to recommend it to my own students as a text, especially if it were to be the first text. The book is very light on discussion of the important—and usually very difficult—concepts. Why is a phonon called a quasi-particle? Why the name Umklapp-process? What is created by a creation operator? Why are some particles bosons and some fermions? None of these questions is answered—or asked. This is a great pity because a useful book could have become a classic. It would also have been worthwhile to discuss and underline the similarity and difference with other quasi-particles (or " 'ons", as the author calls them in chapter 8).

The coverage of the book is comprehensive and can hardly be faulted. Through a discussion of normal vibrations phonons are introduced in chapter 1. Chapter 2 discusses dispersion curves and in chapter 3 creation and annihilation operators are introduced. In chapter 4 Reissland discusses statistics without, however, really making clear the distinction between various kinds of statistics—after having stated categorically that all particles are bosons or fermions, he mentions that the atomic oscillators follow Boltzmann statistics. Anharmonicity and phonon-phonon interactions are introduced in chapter 5, and the Green function formulation follows in chapter 6. Chapter 7 is devoted to a lattice dynamical treatment of various solid state properties, such as thermal expansion, ultrasonic attenuation, and ferroelectricity. In chapter 8 the interaction of phonons with other " 'ons" is discussed, but I would have expected more than a seven-line paragraph devoted to superconductivity and at least a brief description of the basic ideas (such as the importance of Cooper pairs) would have been welcome.

The book is well produced—although a few names are mis-spelled—and as present-day prices go not too expensive. The author does not mention whom he had in mind when writing the book. I should have thought that it was primarily intended to help starting graduate students in solid-state research, or even the final-year undergraduate, and the copious references will be helpful in this respect. A selection of exercises would have been welcome.

D. TER HAAR