theless, despite my warm welcome for these lectures, it does seem reasonable to complain somewhat about the large number of misprints, and even more about the shortage of punctuation. The subjects being discussed are difficult, but many sentences are unnecessarily long and complicated in structure; without punctuation, many of them need to be re-read many times before their sense becomes sure. The experienced worker in the field might be expected to cope with this, but beginners will find much difficulty. Nevertheless, they should be encouraged to read these lectures, in order to grasp something of their unique spirit and style, to see a living and developing research topic in the hands of an outstanding originator.

R. H. DALITZ

Electromagnetic Lore

Foundations of Electrodynamics. By S. R. de Groot and L. G. Suttorp. Pp. xii+535. (North Holland: Amsterdam, 1972.) Dfl. 140; $43.75.

THE title of this book is a misnomer. The essential thread running through the text is the development of the macroscopic electromagnetic laws, commonly referred to as Maxwell's equations, for fields within continuous media from the microscopic Lorentz-Maxwell equations. The foundations of electrodynamics should refer either to the basic study of the microscopic laws of quantum electrodynamics, that is, the field theories of the photon and of charged particles, or to a discussion of the empirical basis from which the laws are induced. Neither of these alternatives is presented here.

The book is divided into four parts of equal length. Part A concerns the statistical averaging of non-relativistic microscopic classical electrodynamics: a novel feature is the formal development of high-order multipole contributions to the electric polarization field and the magnetization field in the atomic field approximation. Part B develops the same programme but in a covariant form. Half-way through the book (at page 255) we have the derivation of the macroscopic field equations. In Part C these Maxwell equations are again derived but this time from the statistical viewpoint of Wigner's distribution theory rather than from Lorentz-type averaging as in the previous sections. Basically the idea is to represent both states and observables as functions in phase space (as suggested by Weyl) and this approach to the macroscopic laws is carried through so that the macroscopic fields are defined as integrals over the N-particle distribution densities loading the microscopic fields. Part D begins with a discussion of the single-particle Dirac and Klein-Gordon equations in externally driven fields. For spin $\frac{1}{2}$ particles the Darwin-Breit interactions between two such particles is developed up to terms of order c^{-2} and the book ends when macroscopic laws for spin media are obtained and their application to magnetostriction pointed out.

Considering the aim of this book, the weakest point is in the discussion, or rather the lack of discussion, of the constitutive relations. These are the relations that connect the polarization and magnetization fields, or alternatively the displacement and auxiliary fields **D** and **H**, to the electric and magnetic fields. It is only in the simplest media that $\mathbf{D}=\varepsilon\mathbf{E}$ and $\mathbf{H}=\frac{1}{\mu}\mathbf{B}$ as one learns at school. Even these basic possibilities are hardly touched on, let alone the cases of anisotropic, non-linear or active media. There is no hint, for example, that **D** could depend on **B** or **H** on **E**. On the other hand, what are done well are the steps (known as the atomic field approximation) which introduce the microscopic polarization fields in terms of the sources of electricity.

The approach throughout is fairly formal with less discussion on physical aspects than many readers would like. Some pages (for example, 207, 222, 432, 505) are formidable and must have been so even to the printer: they are unlikely to be read except by the dedicated. Misprints are rare; but it is unfortunate that the book begins with an error in the Maxwell–Lorentz field equations (page 1). There is some relief from the formalism in the problems set after most sections and also in the occasional archaic expression reflecting that English is not the authors' first tongue. This book is really only of interest to specialists in this field. E. A. POWER

Heterocyclic Chemistry

Heterocyclic Chemistry. By J. A. Joule and G. F. Smith. Pp. viii+362. (Van Nostrand Reinhold: London and New York, September 1972.) £6.25 cloth; £2.75 paper.

THIS book is written strictly for the student: the treatment proceeds in easy stages, with frequent repetition of the basic concepts and in an open style that is easy to read. The authors have correctly drawn on the many advances made over the last ten or fifteen years in the presentation of heterocyclic chemistry, and base their treatment on a sound mechanistic foundation. The book certainly does not aim too high; there is little mention of theoretical or spectroscopic methods, but the kernel of the subject will perhaps be the easier to grasp for this.

The book is carefully written and contains few printing errors. I found only one serious error of fact—concerning the treatment of dipole moments on page 12 where the authors (who are here in good company) fall into the error of ascribing the direction of the dipole moment of pyrrolidine to lie in the plane of the ring, whereas it must be at a considerable angle to this plane as the nitrogen is sp^3 hybridized.

This book is to be recommended as one of the best available texts on heterocyclic chemistry for undergraduate and beginning graduate students.

A. R. KATRITZKY

Thermodynamic Data

Specific Energies of Galvanic Reactions and Related Thermodynamic Data. By J. G. Gibson and J. L. Sudworth. Pp. xvi+820. (Chapman and Hall: London, January 1973.) £10.

ALTHOUGH the principal users of this book must necessarily be a comparatively small group interested in the possibility of new electrochemical power sources, there is every reason to be grateful to the authors for putting on record, in a professional and competent way, an exercise which must have been attempted many times by a less sophisticated and most certainly less adequate search and compilation of derived data.

Sources of the basic thermodynamic data are to be found on page XVI and, reasonably enough, it will be observed that all the references are to recent compilations with no recourse to original papers. For readers with a particular interest in specific reactions, the location of the original source of information should not prove difficult.

As with all compilations of this kind, effective use depends on a clear statement by the authors as to the procedures involved and the systematic layout of the tables. This information is set out with clarity in the short introduction. The data set out for each couple give—with of course the elementary assumption of no kinetic hindrance and a single reaction—the theoretical specific energies, cell voltage and temperature coefficients of the galvanic reaction. In addition the standard enthalpy of formation, the standard Gibbs free energy of formation and the standard entropy of formation as used in the derived tables are set out for all the inorganic compounds involved; that is the oxides, sulphides, fluorides, chlorides, bromides and iodides. The elements relevant to the calculation, with the additional information of transition temperatures for phase changes, are listed in the last table of the book or in an appendix.

In all, this is a very useful compilation and a necessary library source book, even if recourse to it may often be infrequent. H. R. THIRSK