subjects as the nature and origin of froth flows and tuff lavas.

Despite these criticisms, this book is clearly a "must" for all students of volcanoes and volcanism, and must now be regarded as the standard source book on this subject.

G. P. L. WALKER

Differential Equations

Theory of Partial Differential Equations. By Melvin H. Liebertstein. Pp. xiv+283. (Academic: New York and London, September 1972.) $16.50.

THIS book is intended to provide an introductory account of the theory of partial differential equations for graduate students of engineering, physics, and possibly also applied mathematics. It has been written in four distinct parts. Part I, which comprises five chapters, gives an outline of the classical development of the subject. This ranges from an elementary account of the theory of characteristics and of the classification problem in E^2 to boundary value problems for the Laplace equation and the heat equation. It also contains a chapter sketching the notion of a properly posed problem.

Part II comprises four chapters, giving some results for both linear and nonlinear equations. These include the Riemann method, distortionless transmission line theory, and a helpful introduction to the Cauchy-Kovalevski theorem. Parts III and IV between them contain six short chapters. Potential theory and the Cauchy problem for the wave equation in terms of a retarded potential occupy Part III. Part IV offers a cursory discussion of some more recent ideas: it attempts, in forty-eight pages, to discuss the significance of *a priori* estimates, error bounds in numerical solutions and the existence of L^p weak solutions, while at the same time offering an outline of some functional analysis prerequisites.

Although an attempt to make the theory of partial differential equations better understood by engineers and physicists is to be welcomed, it is very doubtful that this book will be the vehicle by which this is achieved. It is certainly an interesting attempt, but it is too short, too selective, and too uneven in level. Thus on page 12 the reader is expected to know the meaning of the logical conjunction symbol $\wedge$, yet in the previous pages a first year derivation of D'Alembert's solution is offered. This unevenness of presentation mars an expository text, as does the failure to discuss first order systems, the absence of any systematic account of integral equations or of variational methods, and inconsistency of spelling (Kovalevski(y)).

A. JEFFREY

Liquid Metals

Liquid Metals: Chemistry and Physics. Edited by Sylvan Z. Beer. (Monographs and Textbooks in Materials Science.) Pp. x+731. (Marcel Dekker: New York, 1972.) $19.50.

ON page one of this work there appears the remark ". . . physicists and chemists may not be familiar with the formalism commonly used by metallurgists . . . the goal . . . is to outline the formalism and to explain some of its characteristics". This is an excellent spirit in which to start a volume containing review articles by physicists, metallurgists, and chemists written for the benefit of all research workers in the liquid metals field. Let me say at once that the book will be of great value to any laboratory seriously interested in liquid metals, and it is no detraction to add that in any case there is nothing similar available.

The work deals with science, not technology. Fifteen articles, by experts in their fields, span most of the topics one would expect to find. The main emphasis is on comparing observations with theory, but there are substantial sections on experimental techniques and a useful amount of tabulated data. Perhaps the most conspicuous absentee is inelastic neutron scattering and thermal motion but, on the other hand, there are unexpected fringe benefits in the articles on solid non-crystalline alloys and evaporation kinetics.

As a physicist I was grateful for the lucid introduction to metallurgical thermodynamics in chapter 1, and metallurgists and chemists should be correspondingly pleased with the excellent articles on optical, magnetic and electronic properties. Most of the equations one is likely to want in diffraction analysis are set out by Wagner who deals extensively with multi-component systems and with technical questions like error analysis. Very readable chapters are available on viscosity, diffusion, and on electro migration—a subject "once considered mysterious" as the author puts it. The varied fortunes of significant structure theory applied to liquid metal properties are illustrated by Breitling and Eyring while Lee and Lichter attempt to relate thermodynamic properties with electron transport in alloys—an ambitious effort not wholly convincing to me. Sound propagation, high pressure effects and surface tension are the remaining subjects, all providing much of interest.

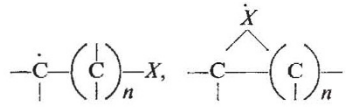
The printing and presentation are clear and the separate systems index is a useful feature. The book needs two complements: an expository textbook conceived as a whole and displaying the subject logically, and a collection of more recent material from the past two years. The recent book by Faber, reviewed elsewhere, promises to supply the first, and before long the Proceedings of the Second International Conference on Liquid Metals will supply the second. Since the subject appears to be on a somewhat gently rising plateau of achievement at present, all these three different volumes promise to be useful for several years at least.

N. E. CUSACK

Radical Intermediates

Bridged Free Radicals. By Leonard Kaplan. Pp. xv+481. (Marcel Dekker: New York, September 1972.) $24.50.

THE subject of bridging in free radicals [that is, the relative importance of the radicals



and radicals intermediate between them] has to be considered when rationalizing product distribution, kinetics, energetics, and spectra from many free radical reactions. Currently (see *J. Amer. Chem. Soc.*, **94**, 6550; 1972) the importance of bridged radical intermediates continues to be subject to much controversy.

A large quantity of information relevant to the subject of bridged radicals is buried in the literature, and this book intended as a comprehensive source for reference and teaching is to be welcomed. The various definitions of bridged radicals are critically discussed, and the book has chapters on silyl-, germyl-, stannyl-, chloro-, bromo-, iodo-, sulphur-, cyano-, and vinyl-substituted radicals. Selected data relevant to particular bridged radicals are briefly and sometimes critically discussed, and the inclusion of comprehensive tables, with extensive footnotes, makes it possible for the reader to draw his own conclusions, as is the intention of the author. This may be possible for readers expert in free radical chemistry, kinetics, stereochemistry, thermodynamics and spectroscopy; however, a person requiring to know if a particular radical is likely to be bridged may be overwhelmed by the welter of tabulated experimental results on which much effort must be expended to arrive at a meaningful conclusion. The mass of detailed tables, the continual necessity to refer to footnotes and to earlier sections, make the book difficult to read. In my opinion the book will be primarily of value to the expert in the field of bridged free radicals. The non-expert, be he teacher or student, may well be baffled by the scarcity of summaries and definitive conclusions.

D. I. DAVIES