

be greatly hampered owing to the omission of free energy functions.

Table IV contains the computed boiling points at different pressures; Tables V-XXV contain the computed vapor pressures at even temperatures; and Table XXVI contains the computed vapor pressures at the melting points.

An interesting graph giving the pressure ranges of the experimental methods is presented on page 119, and another giving the pressure ranges over which the vapor pressure of each element has been measured appears on pages 394-395.

The book can be used in three ways, one of which is excellent, one very good, and one terrible. It should be an excellent source of information on vapor pressure methods, especially for those just entering the field. It provides a large and very useful bibliography, which, however, contains many errors. Its tabulated results should be used as they appear only by one who wishes numbers regardless of their reliability.

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Fused Salts. Edited by BENSON ROSS SUNDHEIM, Department of Chemistry, New York University. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 1964. 435 pp. + ix. 16 × 24 cm. Price, \$18.50.

This is a valuable book for acquainting the scientist with the state of the art in most aspects of molten salts. It consists of seven reviews in various fields of fused salt research, each written by one or two authorities in the field. Most of the reviews discuss the results of the application of one broad discipline to the study of molten salts. In general, the authors assume the reader has more than an elementary acquaintance with the theory of the discipline. As a result, the book will be useful to the researcher in fused salts interested in results from the application of other disciplines than his own, or to the researcher who is concerned with the disciplines themselves and interested in their application to fused salts. This volume probably will have little value for the undergraduate student.

On the whole, the reviewer considers this to be a good book. It has the advantages that arise from being written by several authorities on the subject. The technical level is high, and the content reflects the latest thinking on the subject of molten salts. Most of the authors point out areas that would probably prove fruitful for further research—an attractive feature. Unfortunately, the book also has the disadvantages of a compilation of a set of review papers. There is a certain amount of duplication of effort, some of which is helpful, but some should have been edited out. Also there is a lack of consistency of the symbols used from one chapter to the next. This last is not serious, however, since the reader should be familiar with the various sets of symbols.

Chapter 1, "Structural Aspects of Ionic Liquids," by H. Bloom and J. Bockris, starts with a review of various theories of liquids as applied to fused salts. This is followed by a digression into transport phenomena, which might well have been left to the chapter on the subject. An interesting comparison is then made of the ability of the various theories to predict data. The closing section discusses evidence for identifiable species in mixtures and the meaning of complex ions in fused salts. This reviewer found it strange that the authors completely ignored the very important X-ray studies of pure fused salts.

Chapter 2, "Thermodynamic Properties of Fused-Salt Systems," by T. Førlund, is an excellent discussion of the subject. After a brief introduction the author derives the thermodynamics of mixtures for various structural assumptions. This is followed by a review of experimental methods. The concluding section covers experimental results and their significance regarding species and complex ions in melts.

In Chapter 3, B. Sundheim reviews "Transport Properties of Liquid Electrolytes." This starts at a very sophisticated level, but a persistent reader will find things get easier as he progresses. In fact, it might be recommended that the three sections of this chapter be read in reverse order. The last section, Discussion, is a very readable account of the concepts involved. The Experimental Methods section provides a compilation of data as well as a good description of methods. The first section on Phenomenolog-

ical Treatment discusses the application of the thermodynamics of irreversible processes to transport in molten salts and requires some background in the field for complete understanding.

"Electrochemistry in Molten Salts" (Chapter 4) by H. Laitinen and R. Osteryoung specifically excluded "static" electrochemical methods, presumably because this is well enough treated in other recent reviews. The authors discuss several comparatively new techniques from aqueous electrochemistry which have been applied recently to fused salts. These are primarily chronopotentiometry, impedance methods, pulse techniques, and polarography. The methods hold promise of providing information on the kinetics of electrode processes. To date, however, the results seem to be primarily diffusion coefficients of cations dissolved in fused salt solvents.

D. Gruen presents a very interesting account of "Spectroscopy of Transition Metal Ions in Fused Salts" in Chapter 5. In an introductory section he describes the spectra of salts that can be used as solvents. Then he gives an interesting discussion of the spectra of 3d ions in chloride melts—how the spectra give the symmetry of the field around the cation and hence the species or complex in which the ion exists. Results for 4f and 5f ions are subsequently discussed, but these are not so readily interpreted.

Chapter 6 is concerned with the "Solution of Metals in Their Molten Salts," and J. Corbett has presented an excellent review of this subject. An historical introduction is followed by a section on experimental methods. A discussion of experimental results follows. The final section presents the theories and models proposed to account for the properties of these solutions. The chapter reflects an effective survey of the literature for hard-to-find, pertinent references and the author presents a careful, impartial evaluation of the data. His closing quotation from Robert Frost seemed particularly appropriate.

Chapter 7, "Reaction Kinetics in Fused Salts," by F. Duke, is a brief review of a half-dozen of his own papers. The reader may feel that, by reviewing only his own work, the author is unduly egocentric. However, a little investigation will show that there is, indeed, very little other work except some studies of the decomposition of pure salts, and the author is justified in treating only his own papers.

It seems worthwhile to call the readers' attention to some recent, related books. "Molten Salt Chemistry" edited by M. Blander (Interscience Publishers, New York, N. Y., 1964) is a very similar compilation of several treatises by different authors. The book "Electrochemistry of Fused Salts" by Iu. Delimarskii and B. Markov, translated by A. Peiperl and R. Wood (Sigma Press, Washington, D. C., 1961), covers electrochemistry only. There is also a recent handbook of data on fused salts: "Physico-Chemical Constants of Fused Salts," edited by the Committee of Fused Salt Chemistry, The Electrochemical Society of Japan.

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Chemistry in Nonaqueous Ionizing Solvents. Volume IV. Chemistry in Lower Fatty Acids and Derivates. By KURT HEYMANN, HEINRICH KLAUS, HORST SURAWSKI, GERHARD WINKLER, HERBERT KNAUER, and LYLE R. DAWSON. John Wiley and Sons, Inc., 605 Third Ave., New York 16, N. Y. 1963. 313 pp. 17 × 24.5 cm. Price, \$12.00.

A voluminous literature exists in the area of nonaqueous solvent chemistry. This literature is scattered through many chemical journals, and the beginning worker is faced with a formidable task when he attempts to familiarize himself with previously published work in a given solvent. The series of monographs initiated by the late Gerhard Jander and by Hans Spandau and presently edited by Hans Spandau and C. C. Addison are designed to gather together in one place the literature pertaining to one solvent or a series of closely related solvents. This volume is fourth in a series "Chemistry in Nonaqueous Ionizing Solvents" and specifically concerns itself with the solvents formic acid, acetic acid, acetic anhydride, acetamide, and formamide and derivatives of amides.

Chapter 1 by Kurt Heymann and Heinrich Klaus, "Chemie in wasserfreier Essigsäure" (127 pp.), is an extremely thorough compilation of the acetic acid literature. Salient features of most of the articles discussed are given including much original data and figures. The material is presented systematically, starting with the discussion of the properties and preparation of acetic