

found in typical cases may seem surprising to anyone inclined to ignore diffusion and look upon a flame as a purely thermal phenomenon". The importance of diffusion in sub-atmospheric flames is brought out very clearly here.

The final two chapters deal with the information which can be deduced by applying the conservation equations to data on laminar flames. The two chapters cover the results on physical properties of flames and chemical reaction rates in flames, respectively; the latter subject is generally the principal reason for studying flames of this type. The chemical reactions considered are only those which are thought to occur in normal flames and the detailed descriptions of low temperature or "cool" flame kinetics which are commonly substituted for a discussion on combustion chemistry are not included. An account of the analysis of a fairly complete set of data on methane-oxygen flames is given as an example of the kind of information which can be obtained. Included also are summaries of the values of rate constants for elementary reactions in flames, given in the form of Arrhenius plots whenever a sufficient range of values is known.

Within its framework this book is first rate and will be found very valuable by research workers interested in high temperature gas phase kinetics and by combustion engineers who need to make measurements of flame properties. Unfortunately, as a good deal of the material which appears here has been published previously, it is likely that many who would like to have their own copy of this book will find the price too high.

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## PROGRAMMING AND FLOW

### Programming, Games and Transportation Networks

By Claude Berge and A. Ghouila-Houri. Translated by Maxine Merrington and C. Ramanujacharyulu. Pp. x+260. (London: Methuen and Co., Ltd.; New York: John Wiley and Sons, Inc., 1965.) 55s. net.

This book consists of two parts of nearly equal length. The first part, by Prof. Ghouila-Houri, is entitled "General Theory of Convex Programming", and devotes its first three chapters to an account of the pure mathematics needed later in the book. The topics considered include vector spaces, linear manifolds, convex sets and convex functions, open, closed and compact sets, continuous and semi-continuous functions, convex hull of a set, intersections of convex sets, Von Neumann's minimax theorem and the Farkas-Minkowski theorem. The presentation is clear and is adequate for a reader well grounded in a modern approach to pure mathematics, but those who do not possess such a background and are more interested in applications than in mathematical foundations would find the reading severe. The next two chapters are concerned respectively with programming and with convex programmes with linear constraints, and are still mainly of a theoretical nature. The final chapter of Part 1, the shortest in the book, deals with games of strategy and is at a less abstract level than the preceding chapters.

The second half of the book, by Prof. Berge, is entitled "Problems of Transportation and Potential". The first two chapters give the necessary theoretical background of graph theory and a general theoretical study of flows and potential differences. The central theme is that of duality, first between cycles and co-boundaries of a graph, then between trees and co-trees, continuing with a planar graph and its dual graph, strongly connected graphs and graphs without circuits, flows and potential differences, cyclo-matic and co-cyclo-matic matrices, and finally between the transportation problem and the problem of potential.

The whole treatment has unity and coherence and is extremely elegant.

The remainder of the book is entirely concerned with applications. A large number of algorithms for solving various flow problems are given and there is a chapter devoted to problems related to the transportation problem. The detailed examples illustrate methods due to Dantzig, Ford and Fulkerson, Roy, Minty, and others.

The book will be read with interest and pleasure by those concerned with theoretical aspects of the subject, and with profit by those interested in the applications. Although a number of errors were noted, the presentation is of a high standard and the translation reads well. There is an excellent index.

H. O. FOULKES

## A USEFUL TECHNIQUE

### Agar Gel Electrophoresis

By R. J. Wieme. Pp. xiii+425. (Amsterdam, London and New York: Elsevier Publishing Company, 1965.) 110s.

SOME years ago, in my review of Dr. Wieme's thesis *Studies on Agar Gel Electrophoresis*, I expressed the hope that it would form the basis of a more widely presentable work. This hope has now been realized. Agar gel is, of course, widely used for immunoelectrophoresis, but it is also a useful medium for simple zone electrophoresis, having a separating power between paper or powder slabs and starch or acrylamide gel, and it is to this aspect of its use that *Agar Gel Electrophoresis* is mainly devoted.

The first chapter provides an excellent account of the physics underlying electrophoretic processes in non-convective media and compares the properties of agar with those of other gels. (Incidentally it scarcely seems appropriate to give details in this chapter of the preparation of acrylamide gels, which are not complete anyway.) The next chapter surveys the various techniques used for agar gel electrophoresis. This is followed by a chapter which chooses the three techniques which the author considers to be of most general usefulness. These are a macrotechnique using gel on long glass plates, a microtechnique on microscope slides and a special procedure designated "fluid film" which uses dilute agar. The practical details are very adequately described. In the next chapter quantitative aspects are fully discussed, as are the properties of different varieties of agar, its chemistry and purification and the preparation of agarose (the representation of the linear agarose molecule is not correctly given). There is also a good discussion of various other properties of agar gel—endosmosis, interactions with electrophoretic substances and ion exchange and molecular sieve effects. Next comes a survey of the methods for rendering substances visible following electrophoresis, which provides full details of reagents for proteins, lipids, carbohydrates, nucleic acids and so on. Of particular interest is the description of reagents for substances having enzymatic activity. There is a short but useful section on immunoelectrophoresis giving useful details of preparation of immune sera, electrophoretic procedures and interpretations.

The sixth and final chapter is the longest, occupying seventy-one pages. It is a detailed review of the many applications of simple agar electrophoresis and covers a very wide field. Though it contains much useful information, this chapter suffers from being written in the style of a thesis where everything is included, important or not, and where arguments sometimes verging on the polemical are indulged in over matters not always worth arguing about. This does not help to make for easy reading, neither does the occasionally obscure English. Since 1959, when Dr. Wieme's thesis was published, the applications of agar electrophoresis have grown enormously,