

lubricants and end-products, but now embraces complex chemical processes in the industrial fields of fertilizers, petrochemicals, plastics, rubber, to name only a few branches, then this question would appear to have some substance in fact.

The problem is by no means resolved by appeal to the titles of the eight contributions contained in the present volume. These are: "Advances in Large-scale Oxygen Production", by R. L. Shaner and L. C. Matsch; "Hydro-dealkylation", by G. F. Asselin; "Formulation and Structure of Lubricating Greases", by B. W. Hotten; "Thermal Cracking and Pure Saturated Hydrocarbons", by B. M. Fabuss, J. O. Smith and C. N. Satterfield; "The New Elastomers", by W. W. Crouch and R. S. Hammer; "Mechanisms of Carbonium Ion, Carbene and Carbanion Reactions", by G. M. Cramer and T. J. Wallace; "Synthetic Ammonia", by S. Strelzoff and L. C. Pan; "The Chemistry of Fuel Instability", by T. J. Wallace. A glance at the cumulative index of the specialized subjects dealt with in the nine volumes published so far spreads the net very wide indeed, but this presumably was the purpose of the series in the first place.

The series as yet does not add up to a text-book which the student can read to learn more of his chosen subject. Neither is it a cohesive dictionary of either petroleum chemistry or refining. It is, in fact, a reference series written by specialists for specialists and, as such, a valuable source of information on many subjects to those who wish to keep abreast of modern developments in the sciences and technologies wherein their main interests lie. Refresher courses in the sciences in which professional men and others have long since qualified are constantly in the minds of practising chemists and chemical engineers; those engaged in the petroleum industry, including its widest ramifications, are by no means behind members of other faculties in their recognition of the importance of revitalizing their work, but time and circumstances do not always permit such seminars. This series of volumes does, within obvious limitations, at least provide a useful means of leisure-study in the specialized subjects so far treated; to this extent it undoubtedly fills a gap in contemporary technical literature of scientific progress of petroleum technology which future volumes may well gradually narrow.

H. B. MILNER

ADVANCES IN CHEMICAL ENGINEERING

Advances in Chemical Engineering

Vol. 5. Edited by Thomas B. Drew, John W. Hoopes, jun., Theodore Vermeulen and Giles R. Cokelet. Pp. x + 317. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1964.) 100s.

THE five topics in Volume 5 of the Academic Press series, *Advances in Chemical Engineering*, are all processes involving reaction kinetics or transport processes. Each represents a valuable contribution to the literature in the field concerned. Three of the authors are American, one is British and the fifth is Dutch.

The first article, on flame processes, by J. F. Wehner, is an excellent review of the fields of combustion and detonation. The author has approached the subject by acquainting the reader with the general theories of flame processes and shows how some useful approximations can be made to the equations for mass and heat balances within a flame. Experimental techniques for measuring temperature and concentration profiles are discussed and the importance of a prior knowledge of the magnitude of the reaction rates is emphasized. This is illustrated by investigating the probable chemical stages in the combustion of methane and showing the difficulties of estimating the concentration profiles of all the molecular species present. The hydrodynamic stab-

ility of stationary and propagation flames is approached with special reference to ignition and quenching. The transition from the laminar combustion wave to the shock wave is discussed in terms of the hydrodynamic conditions preceding the detonation. The burning of solid propellants is shown to be a particularly difficult problem because of the intermediate mixing problems involved. The article concludes with the possible applications of flame processes in chemical engineering. The flame is regarded as a form of chemical reactor from which normally short-lived molecular species might be isolated by quenching. An interesting possibility is the condensation of finely divided solid particles from flames.

The use of bifunctional catalysts which are discussed in the second article, by J. H. Sinfelt, represents an important application of heterogeneous catalysis within the chemical industry. These materials have been developed during the past ten years, particularly in petroleum refining, and there are now many opportunities for their more extended use. In the article, the general principles of functioning of such catalysts and the nature of the reactions occurring have been described. Hydrogenation and isomerization are taken as illustrative examples. Some of the outstanding problems to be solved before the catalysts can be widely used have not been presented, however. Thus, heat and mass transfer receive a rather perfunctory treatment even though they may be determining factors. Methods of preparation of bifunctional catalysts could well have been discussed in this article, particularly whether it is advantageous to include two components in the same catalyst pellet.

Heat conduction or diffusion with change of phase is the subject of the article by S. G. Bankoff. A number of diffusional processes, with both constant and variable diffusion coefficients, are discussed, and it is concluded that the subject is well developed in cases where the boundary conditions are simple. There are, however, many problems involving, for example, the melting of solids or the condensation of material on nuclei where the phase boundary is continually moving. Analytical solutions are given to a number of problems and numerical methods are also developed. On the whole the article would have been improved by a clearer statement of the physical problems presented and by a less piecemeal approach.

The article on flow of liquids in thin films by G. D. Fulford is a useful review of the hydrodynamics of such systems. There does not appear to have been a previous review of this important field, but the long list of references shows the amount of work carried out in recent years. The author is to be commended on providing a list, at the end of his review, giving a brief résumé of each of the major contributions in the field. The only criticism is that the treatment of the mechanical energy equations for unsteady systems is inadequate.

The volume concludes with an article by K. Rietema on segregation in liquid-liquid dispersions and its effect on chemical reactions. He reviews the concepts of flow patterns in reactors suggested initially by Danckwerts and then goes on to examine the effect of segregation on conversion rate for reactions of various orders. The effects of limitation due to mass transfer are considered with reactions proceeding both in the continuous and disperse phases. In many cases the behaviour of a process is difficult to interpret because of a lack of basic knowledge of the kinetics of the reaction in question. In stirred vessels, the effect of dead corners at baffles and the effect of increase in mean drop size with distance from the stirrer are examined. This article is particularly useful, as the field is one attracting an increasing number of investigations at present.

The volume is attractively produced, in the same style as its predecessors. It is, overall, a work of a high standard, but is expensive for its length.

J. F. RICHARDSON