though the section on temperate phages manages to preserve several old misconceptions and to propagate some new ones. The presentation does tend to create the unfortunate impression that most of the important questions in molecular biology have already been answered, and it seems a great pity that no attempt was made to stimulate the reader to think about some of the exciting problems ahead.

In spite of its faults, many of which seem inevitable in a text of this scope, Professor Bresler's book should serve as a sound introduction to the subject for anyone with the appropriate background.

W. J. BRAMMAR

Chemical Engineering

Physical Principles of Chemical Engineering. By Peter Grassman. Edited by Dr H. Sawistowski. Translated by R. Hardbottle. Pp. xxx+896. (Pergamon: Oxford and New York, December 1971.) £16.

It has never been easy to define the boundaries of chemical engineering and the great attraction in the practice of the profession is that it demands the gathering together and assessment of a project by using data from a wide range of considerations, including technical and economic. In the United Kingdom the strong growth of the subject as an educational discipline took place from the mid 1940s and the courses then developed were strongly influenced by American texts. There were two main pillars to these courses, the strong influence of physical chemistry and the strong wish to get to the teaching of technology in a form directly helpful for training in the design of equipment. The problem of providing a widely based scientific training coupled with a forward looking technological content could not really be resolved and is still elusive to the three-year degree courses so common in this country.

It was not till Bosworth wrote his *Physics in the Chemical Industry* that the very significant part played by physics was sharply brought out but it has not been found easy to include a course of basic physics in our chemical engineering courses. This text by Professor Grassman is welcome not only because of its actual content but because it emphasizes the vital importance of physics and in so doing brings a very different approach to much of the subject compared with that offered by the majority of existing texts.

On the European continent the belief in giving a long course in science to engineers has enabled their centres to provide for a course with a basic physics flavour fitting into the fourth or fifth year of the course. It is difficult to

see how this kind of study can be fitted into any undivided form of three-year course, but it is well to remember that this is lacking from these shortened British courses.

In this treatment based on physical principles, all operations governed by the same aspects of physics are considered together, giving a more generalized analysis than that provided by the concept of "unit operations", but such an approach is in no way engineering in outlook. This form of thinking is implied by the titles to such chapters as (10) "Multiphase Flow Processes", or (7) the "Applications of Fluid Dynamics". The former covers filtration, fluidized beds, gas bubbles in liquids, atomization, foams, emulsions as well as two phase flow in pipes.

An indication of the contents is given by considering some of the chapters. Thus the first three chapters "Mass and Energy Balances", "Concept and Use of Energy", and "Probability Theory and the Kinetic Theory of Gases" indicate well the basic physics and the section on Maxwell's velocity distribution and that on diffusion provide a particularly stimulating discussion. Chapter 5 on "Bodies with Large Surface Areas" covers porosity, size, shape of particles, drop size distribution of liquids, packings, and a refreshingly interesting discussion on the efficiency of size reduction. Chapter 7 on "Applications of Fluid Dynamics" covers flow in pipes, eddies, mixing, residence time distribution, turbomachinery, design principles of pumps and compressors.

Whilst there is no special chapter on either heat or mass transfer chapter 9 covers heat, mass, and momentum transfer, taking every possible opportunity to indicate the similarities and differences. Thus the section on boiling liquids contains a discussion on the really basic problem of nucleation, in many ways a mass transfer problem. Again the dimensionless groups in heat and mass transfer are considered together and used to discuss turbulent transfer.

Chapter 11 on rheology shows the extending nature of the subject and chapter 4 on the physics of solids although too concentrated does raise a number of problems not commonly discussed.

This text although in the *Chemical Engineering* series will prove of considerable value in some of the modern courses on engineering and science and it will also prove helpful to those mechanical engineers who wish to have a much better understanding of their own processes. It is not an easy text to read but the reader who wishes to dig into the real problems that are so often glossed over will benefit and find it stimulating and thought promoting.

This form of presentation will also

prove useful to advanced students and to those teachers who are seeking inspiration and a new approach to their subject. We must therefore thank Pergamon Press for bringing to our notice another European text.

Dr R. Hardbottle, the translator, and Dr H. Sawistowski should both be congratulated on their valuable contribution to this study.

J. M. COULSON

Phonons in Crystals

Thermodynamics of Crystals. By Duane C. Wallace. Pp. xviii+484. (Wiley: London and New York, April 1972.) £8.85.

THE scope of this book is narrower but deeper than its title may suggest. It concentrates on the theory of those thermodynamic properties of perfect crystals which are vibrational or electronic in origin, excluding such topics as phase transitions and interactions with electromagnetic fields. In compensation, it expounds the theory of vibrational and electronic effects starting from ion cores and outer electrons. The result is a successful vertical integration of the thermodynamics of solids and its fundamental theory, in a manner not previously attempted.

The author is an expert on the topics he discusses, so that this book is self-contained and authoritative. The theory is comprehensive: for example, it treats both renormalized and self-consistent phonons, as well as electron-phonon interactions. At the same time, there is an emphasis on results suitable for numerical work, with a chapter on model calculations and an appendix on computational techniques. Unfortunately, the book is self-contained to a degree which entails loss of perspective, particularly in the paucity of references to alternative nomenclature and methods. The reader finds thermal expansion coefficients called thermal strain coefficients after one explanation, and what he may know as thermodynamic tensions and effective harmonic frequency spectra never referred to as such. Ideas are elusive entities, not easily indexed and abstracted, and hence especially dependent on full documentation in books, yet here references occur on average only every twelfth page (ignoring the author's self-citations). Experimental data, on the other hand, though more accessible in the literature, are here both documented and tabulated after use in one chapter.

Notwithstanding the idiosyncrasies, *Thermodynamics of Crystals* fills a gap in the literature, and makes profitable reading for anyone concerned with thermal and elastic properties of solids.

R. W. MUNN