beyond elementary differential equations and the fundamentals of matrix algebra.

The dynamics of crystal lattices and the theory of space groups which are developed in chapters 3 and 4 provide the crystallographic basis for the interpretation of the vibrational spectra of crystals. Factor group analysis is derived from first principles and illustrated using a few examples of both molecular and ionic crystals. The Hermann-Mauguin and Schönflies systems of group notation are used together to help crystallographers and molecular spectroscopists to understand each other. The next chapter continues with the introduction of classical electromagnetic theory to treat the interaction of crystal vibrations with electromagnetic radiation.

In the final three chapters, applications of vibrational spectroscopy to the determination of potential constants and structures and to the study of polymer systems and impure crystals are considered. The methods presented for the vibrational analysis of polymer chains and crystalline polymers should prove useful to workers in the field of polymer science and biochemistry where spectroscopy can provide a considerable amount of structural information.

The final chapter emphasizes the spectroscopic similarity of doped crystals and matrix isolation systems. In both cases the vibrational spectra are characterized by the effects of guest-host-lattice interactions and "localized" lattice vibrations. The addition of a number of valuable tables, as appendices, should increase the practical use of this book for the interpretation of the vibrational spectra of crystalline solids.

Professor Turrell has written a most helpful book which should appeal to very many chemical and physical spectroscopists. The book is a real contribution to the spectroscopic literature and no solid state spectroscopist can afford to be without it. This is a book that we have needed for a long time and for which much gratitude is due to its author.

G. R. WILKINSON

Sliding Solids

Friction and Lubrication of Elastomers. By Desmond Moore. Pp. xvii+288. (Pergamon: Oxford and New York, June 1972.) £7.50.

THE friction between sliding solids arises from two main causes: adhesion at the interface and the deformation of one surface by asperities on the other. Twenty years or so ago it was shown that in the sliding of hard asperities over rubber the deformation component of the friction could be calculated in terms of the viscoelastic losses in the rubber. A little later, experiments showed that the adhesion component was also a function of the viscoelastic properties of the rubber though the time scale was appreciably different. These experiments led to a "unified" approach to rubber friction along two main lines; an atomic mechanism due to Schallamach in Britain, Bartenev in Russia and Savkoor in Holland; and an engineering approach by Bulgin in Britain and Kummer in the United States. The present book, which is intended for engineers, represents essentially the engineering approach to rubber friction. The author has been much influenced by Dr Kummer and has indeed dedicated the book to his memory. Professor Moore does give weight to the atomic approach but a physicist would prefer to see this given greater emphasis. There is, for example, no discussion of the atomic model of rubber elasticity. There is an excellent chapter on viscoelasticity but it is all in terms of spring-and-dashpot models: there is no serious consideration of the molecular processes by which viscoelastic energy is dissipated, and no explanation of the physical meaning of a thermally activated process. Engineering students may, as a result, find it a little difficult to understand the atomic models of friction described in a later chapter since all of these, in one form or another, are essentially an extension of the Eyring rate-theory.

The author does not emphasize sufficiently the possible role of frictional heating on the viscoelastic process itself. There are good engineering models which provide a fairly reliable means of calculating the temperature generated (*a*) at the interface by the adhesion component of friction and (*b*) below the surface by the deformation component of friction. It is important to know to what extent such thermal effects, particularly at engineering speeds, modify the assumptions concerning the relation between viscoelastic properties and friction and wear. In the section on wear and wear mechanisms there is no reference to Schallamach's fascinating correlation between wear and viscoelasticity in the skidding of automobile tyres. Finally the author commits a rather intriguing solecism by translating a Gedanken-modell due to Prandtl as a "thinking" model—it was Prandtl who was doing the thinking, not the model.

Having expressed these comments it is only right for me to add that Professor Moore has produced a very systematic and timely survey of an area in tribology of great practical importance. The author clearly has a teaching course in mind, the book being aimed at third year engineering students or research men. He stands no nonsense, states his assumptions clearly, and proceeds to work out specific models. Research men might prefer less arithmetic and a more critical assessment of the models and the assumptions. But students who wish to acquire a useful down-to-earth background to tribological aspects of elastomers will find it an extremely useful and informative introduction, although there are some confusing errors in the figures and text that need correcting. Apart from these defects, the book should prove of great value to teachers and students interested in the field in general and in particular to those concerned with the action of seals and the performance of automobile tyres.

DAVID TABOR

Dye Fundamentals

Fundamentals of the Chemistry and Application of Dyes. By P. Rys and H. Zollinger. Pp. ix+196. (Wiley: New York, London and Sydney, August 1972.) £6.

WORLD dyestuff production runs at 560,000 tons per annum with a total value of 1,650 million US dollars. It is concentrated largely in five countries, the USA, Germany, Japan, Great Britain and Switzerland, which account for 55% of the production and 68% of the value. Thus dye chemistry is an important activity for a large number of organic and physical chemists. Surprisingly the organic chemistry of dyes, and even more so the physical chemistry of dye adsorption, receive scant attention in chemical education outside those few centres which make these topics their special concern, for example, at Leeds, Basle and Zürich. The authors of *Fundamentals of the Chemistry and Application of Dyes* believe that this springs from simultaneous growth of organic chemistry and the dyestuff industry over the past 120 years so that the latter is often felt by chemical purists to be relatively uninfluenced by modern chemical thinking. This view is quite wrong but there is some excuse for those outside the industry believing in it. Books on dye chemistry usually fail to reflect the movement of physical chemistry. On the one hand we have Venkataraman's monumental but uncritical review *The Chemistry of Synthetic Dyes*, while on the other there are general works in the old style such as Allen's *Colour Chemistry*. This new book by Rys and Zollinger based on their lectures at the ETH Zürich makes a welcome break with tradition. The main concern of the authors is with dye chemistry which is discussed throughout in physical-organic and mechanistic terms. The authors have adopted a simple and useful chemical classification of dyes which clarifies discussion. The main reactions of importance, for example, diazotization, are discussed in