may make it difficult to utilize the improvements in resolution which are inherent in the narrow linewidths. One interesting technical development is the use of a 'light pipe' with total internal reflection of the γ-rays, but so far only a limited demonstration has been achieved.

The following two chapters are more hypothetical. Goldanskii, Kuzmin & Namiot discuss the problems in developing a gamma-ray laser. Although many scientists have addressed themselves to this problem in the past, this review shows that a realization of the idea may still be a long way off. The contribution by Cohen on resonance experiments using synchrotron sources is equally speculative, and developments are also likely to be on a long time scale.

The chapter by Gonser & Fischer on resonance γ-ray polarimetry is the only one in the book to describe experiments which can be performed by the adaptation of the more conventional form of Mössbauer spectrometer. The detailed description of the various polarization phenomena is very good and should help others to design their own experiments, but detailed examples are taken mainly from the authors' own work, and the practical use of polarization measurements in determining the orientation of magnetic spins or the orientation of an electric-field gradient tensor is only treated briefly.

The chapter by Sawicka & Sawicki discusses the implantation of iron atoms into host materials and their subsequent study by conversion-electron Mössbauer spectroscopy. The hyperfine effects observed enable a study of implanted iron atoms and their aggregation processes. This technique should become increasingly important as a means of studying solid phases far from thermodynamic equilibrium.

A short chapter by Preston & Gonser on 'selected exotic applications' contains brief reference to experimental tests of relativity theory, and various modulation effects on γ-quanta, which are in keeping with the rest of the book; however, other sections on atmospheric aerosols, archaeology and art, medicine and biology merely refer to conventional Mössbauer experiments on unusual materials and contribute little to the central theme. Similarly the brief account by Hanna of experimental work at the Argonne laboratory in 1959–60 is of historical interest only, and both chapters could easily have been omitted from this volume.

Of the six main chapters, only that on polarization has practical relevance to more than a few workers at the present time, and for most of us this is a book which at best is read quickly out of general interest and then placed on the shelf to gather dust in peace.

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Laser spectroscopy of solids. Edited by W. M. YEN & P. M. SELZER. Pp. xii + 310. Berlin: Springer-Verlag, 1981. Price DM 112.00, US $58.80.

This book is Volume 49 of the series *Topics in Applied Physics*, and the editors have attempted to give the readers a general insight into laser spectroscopy of solids. As has been successful in gaseous spectroscopy of atoms and molecules, the use of the tunable dye laser has allowed the extension and the refinement of optical measurements in the condensed phase to ultra-high resolutions in the frequency and temporal domains. In turn, these experimental findings have led to a more sophisticated theoretical analysis of optically excited states with major modification being apparent in the area of their dynamic behavior. There has been much progress in theory and experiment over the past ten years and this review work has been published at an appropriate time for an understanding of the current status and for further advance of the research in this field.

There are seven chapters. G. F. Imbusch & R. Kopelman present an outline of the optical spectroscopy of ions and molecules in solids. Chapter 2 is written by T. Holstein, S. K. Lyo & R. Orbach, and describes excitation transfer in disordered systems, in which expressions for the rates characterizing the transfer of excitation between individual ions, atoms or molecules are given on the basis of Fermi's golden rule. The calculation shows how centers having different excitation energies can transfer excitations with the assistance of phonon processes. In chapter 3, D. L. Huber gives a brief summary of recent phenomenological theory of the dynamics of optically excited states with emphasis on ion–ion interactions which are responsible for optical energy transfer in condensed phases. The microscopic and macroscopic aspects of the theoretical analysis elucidate the importance of the relaxation mechanisms of an individual optical center due to its interaction with the host, and the propagation of the optical excitation within the solid due to the mutual interaction between different centers; the former process gives rise to homogeneous line broadening and the latter to temporal evolution of the individual fluorescence line.

Narrow-band tunable lasers can be used to excite ions in a small subset of sites, where the absorption frequencies are within the narrow laser width. The luminescence re-emitted by these excited ions will be contained in the same frequency band, which is much narrower than the inhomogeneous line width of material. This is termed fluorescence line narrowing. If the ions are excited by a narrow-band pulse of very short duration, the interesting time evolution of the narrow-band excitation can be studied. Chapter 4 describes the various methods of laser spectroscopy of solids, *i.e.* fluorescence line narrowing, saturation spectroscopy, photon echo and other techniques which have become generally viable with the advent of the high-resolution tunable dye laser. Most emphasis is devoted to fluorescence line narrowing since this is a very versatile method for observing both relaxation and energy migration, and presumably because the author of this chapter, P. M. Selzer, has been an active investigator in this field.

The last three chapters present surveys of the experimental results of laser spectroscopy of ions in crystals, glassine or amorphous solids, and also discussions on excitation dynamics in molecular solids. W. M. Yen & P. M. Selzer provide a useful chapter on high-resolution laser spectroscopy of optically active ions in insulators. M. J. Weber focuses on the experimental results of laser-excited fluorescence spectroscopy of ions in glass. As glass is an inherently disordered medium, the environment of each ion in a glass is not identical. The existence of large site-to-site differences in spectroscopic properties has been demonstrated with exceptional clarity from the technique of fluorescence line narrowing. This chapter is concentrated on laser-excited fluorescence studies, and the author gives a good survey of the present status of the research. A. H. Francis & R. Kopelman discuss briefly excitation dynamics in molecular solids in the same way as those of ionic crystals and glasses. The research on organic and inorganic materials has developed independently and with little mutual awareness of the other's activity. However, the last chapter places emphasis on a unified interpretation of excitation dynamics in both molecular crystals and inorganic solids.

The book covers rather limited areas in the studies of laser spectroscopy of solids. Nevertheless, the subject matter discussed and the way it is presented indicate that this book should be of interest for those involved with material science in general and especially in the areas of optical and electric properties of solids, solid-state quantum electronics and electronic devices. The large list of references supplements well the subject of the book.

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Books Received

The following books have been received by the Editor. Brief and generally uncritical notices are given of works of marginal crystallographic interest; occasionally a book of fundamental interest is included under this heading because of difficulty in finding a suitable reviewer without great delay.

The analytic theory of point systems. By J. D. BERNAL. Pp. xiv + 135, 1923. Published in facsimile and available at £2·50 + postage (30p in the UK) from A. L. Mackay, Dept of Crystallography, Birkbeck College, London WC1E 7HX, England. The name of J. D. Bernal requires no introduction to crystallographers. What is not so well known is that Bernal's first scientific paper was never published. It was written when J. D. was a student – and a rather shy one – at Emmanuel College, Cambridge. Considered to be too long for publication, it did earn him a £30 prize and, more important, a post with Sir W. H. Bragg, which set him on his crystallographic career. This paper, once surviving at Birkbeck College only as a single copy, has now been duplicated and is available, as above, through Dr A. L. Mackay. Introductory notes, by Dr Mackay and by Professor R. Schwarzenberger, are included.