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Further announcements will be made as soon as it is possible to give details of arrangements in other countries.

### Commission on Solid-State Physics

The International Union of Pure and Applied Physics has established a Commission on Solid-State Physics and has invited certain other Unions to appoint representatives. The Executive Committee of the International Union of Crystallography has nominated as its representatives P. P. Ewald (U.S.A.), A. Guinier (France) and W. H. Taylor (U.K.). Crystallographers interested in the work of this Commission are invited to communicate with its Secretary (P. P. Ewald, Polytechnic Institute of Brooklyn, 99 Livingston Street, Brooklyn 2, N.Y., U.S.A.).

### Book Reviews

*Works intended for notice in this column should be sent direct to the Editor (P. P. Ewald, Polytechnic Institute of Brooklyn, 99 Livingston Street, Brooklyn 2, N.Y., U.S.A.). As far as practicable books will be reviewed in a country different from that of publication.*

#### Structure of Molecules and the Chemical Bond.

By Y. K. SYRKIN and M. E. DYATKINA, translated and revised by M. A. PARTRIDGE and D. O. JORDAN. Pp. ix + 509, with 87 figs. and 174 tables. New York: Interscience Publishers; London: Butterworth's Scientific Publications. 1950. Price \$8.75; 63s.

Like many young and rapidly growing subjects, theoretical chemistry is difficult to present as a coherent whole. The subject has, moreover, its own peculiar weaknesses, which often lead the experimental chemist to doubt its value as an independent discipline. It is a commonplace that all the facts of molecular structure could in principle be derived from the wave equation; it is equally well known that this equation cannot be solved explicitly if more than one electron is present. Progress therefore depends entirely upon the shrewd choice of assumptions and approximations in solving the wave equation; and many of the most important con-

cepts, such as 'resonance', 'bond order', 'electronegativity', 'molecular orbital', 'hybridization' and 'ionic character', only have meaning in terms of some particular framework of approximations.

One's immediate questions about a new book such as this are: First, does it make clear the basic assumptions on which the theory rests? Secondly, are the secondary concepts properly defined, and their range of application and limitations fully discussed? And thirdly, how useful will the book be to research workers and students in enabling them to interpret, correlate, and even predict, new experimental facts?

Judged by the third of these criteria, *The Structure of Molecules* is a good book. The qualitative discussion of various molecular properties, particularly in Chapters 8-16, is clear and readable, and packed with interesting examples and useful tables. The chapter on the chemical bond in crystals, which is perhaps of special interest to readers of this journal, is authoritative and well docu-

mented, if not particularly new. Chapter 15, on the boron hydrides, has been almost entirely rewritten by the translators, with curious results. Historically, Syrkin and Dyatkina were among the first authors to revive the bridged structure for diborane and related molecules, and their views on the electronic structure of the bridge are clearly not entirely acceptable to the translators, who give prominence to Pitzer's subsequent ideas, and ignore altogether the extension of the bridge theory to beryllium and aluminium borohydrides. The effect is confusing, and the altered chapter has lost in clarity what it may have gained in modernity.

The more theoretical chapters are not quite so good. It is, of course, wellnigh impossible to do justice to the wave mechanics of atoms and molecules in 140 pages without oversimplifying or passing over the mathematical and physical difficulties. One must admire the ambitious attempt of the authors to do this, and much of the fundamental theory—for instance, the exclusion principle and the variation method—is well explained. But surely some mention should have been made of the fixed-nucleus approximation, and the fact that the *Aufbauprinzip* is only an approximation, even for atoms?

Chapters 5 and 6 show up the resonance theory at its worst, though this does not seem to have been the intention of the authors. We now know that the 'unexcited structures' of large aromatic molecules make scarcely any contribution to the ground state; and counting resonance structures is a theoretically unjustifiable procedure. Also, the theory of ionic-covalent resonance, in its simple form, has not stood up to recent critical examination, and can no longer be taken very seriously. These last two criticisms, however, are mainly based on work which has been done since the book was written, and can hardly be laid at the door of the authors. Chapter 7 has been added in translation, and is a good chapter in its own right, though, as one might have expected, it is not particularly well integrated into the rest of the book.

The printing is good, and the translation intelligent, though it is regrettable that Mulliken's name should have been misspelt every time it is mentioned—more than twenty times.

Taken as a whole, the book is an important contribution to the literature, and is to be recommended to everyone interested in molecular structure.

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**X-ray Identification and Crystal Structures of Clay Minerals.** Edited by G. W. BRINDLEY. Obtainable only from the General Secretary, Mineralogical Society, c/o Geological Society, Burlington House, London W. 1, England; or Prof. R. E. Grim, Department of Geology, University of Illinois, Urbana, Illinois, U.S.A. Pp. 345 with many figures and tables. London: Mineralogical Society (Clay Minerals Group). 1951. Price 35s.; \$ 6.

This important work consists of some fourteen chapters by eleven carefully selected contributors. Every effort

has been made to give a balanced account of theory, methods and results for the different groups of clay minerals. The success attained in securing uniformity of treatment without suppressing the individuality of the contributors is remarkable, and great credit must be given to the editor for this achievement. The particular combination of qualities which have enabled him to do this are clearly seen in the first chapter, which presents a general survey of the structures of clay minerals and of X-ray methods used in their investigation. Where other methods give results bearing upon these problems, they are briefly discussed. Breadth of view combined with precision in detail shows itself throughout this introductory chapter and sets the standard for the whole work.

The second chapter, also by the editor, gives detailed consideration to the kaolin minerals, using this term to include structurally related species whose connection with the kaolins has only recently been traced. Thus, in addition to kaolinite, . . . , nacrite, dickite and the various forms of halloysite (including a new fireclay mineral), we find an account of chrysotile and antigorite, cronstedtite, amesite and chamosite. This is the editor's special field of study, and although the structural situation is far from simple his clarity of style brings the whole into sharp focus.

The next chapter, by Richardson, treats briefly of the phase changes which occur on heating kaolin clays. It will be of especial interest in ceramic applications.

The fourth chapter, by MacEwan, the longest in the book, treats of the montmorillonite group. Here the variables are exceedingly numerous, since, in addition to lattice proxying, we have a variable *c*-axis spacing in which diverse exchange cations and many polar organic compounds can be accommodated. As an aid in X-ray identification the author recommends the use of polyhydric alcohols and gives a number of tables useful in the analysis of mixtures of clay minerals.

The following chapter, which deals with the mica clay minerals, is divided into two parts. The first, by Grim & Bradley, is an expression of the viewpoint of the Illinois group and emphasizes the relationship of the illites to the muscovites on the one hand and the mixed layer minerals on the other. Differential thermal analyses as well as X-ray data are used in these comparisons. The second part, by Brown, gives a detailed classification of the hydrous micas, with graphical illustrations of the way in which details of the lattice may be deduced from the X-ray line intensities.

Chapter vi, by Brindley & Robinson, deals in considerable detail with chlorite minerals. Variations in basal spacing with chemical composition are shown graphically.

The vermiculites, discussed by Walker in the following chapter, seem likely to assume increasing importance in soil science. Methods of distinguishing between these minerals, those of the illite group, and the montmorillonites, are discussed. The fascinating problems of the interlayer water and the exchange cations are fully treated.

The two succeeding chapters, sepiolite by Mlle Caillère and palygorskite-attapulgitite by Mlle Caillère & Henin, provide good summaries of the information available on these fibrous minerals.