

Chemistry sans Dalton

An Introduction to Crystal Chemistry.

By R. C. Evans. (The University Press, Cambridge), 1939. Pp. xii + 388. Price 18sh.

IN the years immediately following Laue's epoch-making discovery, and the *bahn-brechende* investigations of W. H. and W. L. Bragg in 1914 on the application of X-rays to the study of the structure of solids, interest was chiefly directed to a close study of the structures in themselves. It was not long however before it was realised that the arrangement of the 'bricks' into geometrical patterns in different crystals was governed by general laws and had a wider significance both for the physical and the chemical properties of the substances. The work of V. M. Goldschmidt in 1926 on the morphology of ionic crystals can be truly said to lay the foundation of this modern 'crystal chemistry'. Next in 1929, L. Pauling codified in the form of five rules the general principles underlying the structures of all ionic crystals. Since then steady progress has been made in the subject, and the excellent periodical reviews under the authorship of J. D. Bernal and others, appearing in the *Annual Reports of The Chemical Society*, must be familiar to, at least all chemists.

A connected account of this very promising and highly significant phase of modern physical science, is now made available in the compass of a complete book by Dr. R. C. Evans. R. C. Evans has made the subject doubly interesting by eschewing the drier details while critically appreciating the essential developments, and by wielding a facile pen that goes to make an attractive style of writing. The following excerpts culled from different portions of the book, indicate the fare in store for the reader. "Ideally, crystal chemistry should enable us to predict and synthesise chemical compounds having any desired combination of properties whatsoever." "In solids it is the exception rather than the rule for the molecule to have a discrete existence." "The picture of the sanctity of the molecule has created a quite false impression of the importance of the classical laws of chemistry. The Daltonian laws of constancy of composition and of simple stoichiometric proportions now appear as trivial and insignificant conse-

quences of geometrical requirements rather than as profound and fundamental expressions of the laws of nature. The conception of valency, too, so successful in organic chemistry, has been widely, and sometimes blindly, applied in fields altogether outside its scope, until, on chemical grounds alone, it has become clear that certain classes of compounds refuse resolutely to conform to accepted chemical principles." "It is ultimately of little importance whether a given body is described as a chemical compound or not, provided that its structure is known, and the wider significance of that structure appreciated."

In the first three opening chapters of the book, which constitute Part I, the various types of binding forces that hold together a crystal edifice, namely, the metallic, ionic or polar, homopolar or co-ordinate, and the residual or Van der Waals's are discussed, and their quantitative treatments outlined in their essentials. Finally, there is indicated the scope of Bloch's zone theory for unifying the various *ad hoc* treatments of binding forces, and thus leading to a general theory of the solid state.

All the chemical elements and compounds can be classified, although not rigidly, in terms of the different types of binding forces and therefore indirectly in terms of the crystal structures which they possess. The second part of the book on "Systematic Crystal Chemistry" is based on this classification. The first two chapters on metallic systems, which include lucid accounts of the disorder to order transformations leading to the formation of superlattices, and the Hume-Rothery rules for the formation of 'electron compounds', serve to emphasise the great importance of pattern sites, and the need for a wider conception of chemical combination. After a brief chapter on the limited number of more or less purely homopolar structures, the reader is led on to a series of four chapters on ionic compounds. The concept of 'electro-static valency' as the ratio of the charge on the ion to the number of neighbours co-ordinating it, gives a convenient basis for further classifying the ionic crystals into 'anisodesmic', i.e., those with discrete groups in the structure, 'isodesmic' where no discrete groups occur, and 'mesodesmic' structures in which the strongest

binding has an electrostatic valency strength one half of the charge on the anion. The super-polarising power of the H^+ -ion arising from its vanishingly small size, and the consequent anomalous behaviour of compounds containing hydrogen, entitle them to a separate chapter: in this, is also included, a succinct account of the allied topics of the structures of liquids, liquid crystals, and glasses. The descriptions of the various ionic crystals, and in particular the 'defect' structures, with either a statistical distribution of different ions among crystallographically equivalent sites, as in the spinels with 'equipoint' structures, or with incomplete lattices as in Al_2O_3 , and Pyrrhotite, leave the classical chemist searching in vain for a trace of his molecule, and thereby disillusioned about the 'sanctity' of the same.

In the last chapter on molecular lattices, where the bonding is generally by residual forces, the concept of the molecule is restored to its true and proper place. Here the shape of the individual molecules plays an important rôle, and the structures can be broadly classified according to the molecular shape, and the type of inter-molecular force, apolar, polar or ionic. The number of such crystals whose structures have been completely worked out is not large, but to the extent progress has been made, significant

informations regarding the precise molecular configurations, and intra- and inter-molecular bondings, have been obtained, which are otherwise beyond the scope of direct chemical experimentation. A striking example in this connection is the work of J. M. Robertson on the phthalocyanines, for under the favourable circumstances prevailing in this case, he has achieved the first absolutely direct analysis of an organic molecule, and one which does not involve even the assumption of the presence of atoms. Indeed this analysis goes one step further, and the chemist has to stand corrected regarding the distribution of valencies in the molecule. With other complex molecules even the incomplete X-ray analysis at present possible, is not without profit, as it has frequently enabled important conclusions to be drawn about molecular structure merely from the cell dimensions, and the space group, *e.g.*, the sterols and sugars.

The printing and get-up of the book are excellent: just one print mistake has been detected on page 342, line 21, where 'molecular' has obviously to be corrected to 'molecule'. For original sources a choice selection is given, which includes almost all the summarising articles, wherefrom fuller and complete references can be easily had. The book is moderately priced and must find a place in any science library.

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Modern Psychology grapples with Man

Introduction to Psychology. By E. G. Boring, H. S. Langfeld, H. P. Weld and Collaborators. (John Wiley & Sons, New York; Chapman & Hall, London), 1939. Pp. 652. Price 15sh.

READERS of *Current Science* perhaps know that the three distinguished psychologists, E. G. Boring, H. S. Langfeld and H. P. Weld have already published "Psychology: A Factual Text-Book" with the help of collaborators, and a revised edition of that work now appears under a new title, because, "This new book is so much more than a revision of the old that we have given it a new title" (p. vii, Preface). New chapters, new collaborators, revision and rearrangement of chapters, occasional expansion and condensation of contents of certain chapters should be deemed sufficient justification for the advent of a new book.

Not for these and many other features that may become apparent to those who peruse the volume will it be welcomed. The book commences with a specific question: What is man? The opening chapter is entitled "The Nature of Man". The concluding chapter repeats the title, and has a thick-face type sub-heading or commencement *Da Capo* "as at the end of a passage of music" (p. 627). Without keeping anyone in suspense, the question is almost immediately answered. What is man? "A man", the distinguished authors answer, "is a mass of protoplasm moving about on the face of the earth". What is the chief characteristic of man? His conduct is dominated or right through governed by needs. To satisfy countless needs, he "acts, learns, thinks and perceives". Let the matter be clinched. What is a person? *Needy protoplasm with*