

THE CHEMICAL BOND, IN THEORY AND EXPERIMENT

Valency : Classical and Modern

By Dr. W. G. Palmer. Pp. x+242. (Cambridge : At the University Press, 1944.) 10s. 6d. net.

HERE is no branch of chemistry in which greater progress has been made in the last twenty years than the study of valency. A full understanding of the principles of chemical combination demands a versatile mind : for it needs to be familiar with what we may call pure chemical reasoning and experiment ; it must be on friendly terms with most, if not all, of the tools of modern physics (X-rays, electron scattering, vibration and rotation spectra, electric oscillations, and so on) : and lastly, it must not despise mathematics (did not Dirac say, in effect, that all chemistry is a branch of mathematics ?). He who writes a book about valency must decide from the start what kind of approach he will make. To be all-inclusive would require more space than the bare 250 pages which Dr. Palmer has allowed himself ; some selection has to be made.

"Valency : Classical and Modern" is a book about chemistry : it is written by a chemist for chemists. But it has this advantage over the old type of chemical treatise, that all other aids to understanding are welcome. So there are paragraphs about the measurement of dipole moments and the interpretation of spin and term diagrams, not usually found in such books. It is hard work fitting everything in, especially when the general approach is historical, so that space is also granted to Dalton and Berzelius. Indeed it is quite remarkable how much information is to be found in this little book. Thus we begin with a historical account of the ideas that led chemists to associate a definite valency (or several possible valencies) with a particular atom. This leads to the periodic system, though it is still unnecessary to introduce specifically electronic theories. The next chapter is devoted to various methods of determining structure and valency ; these include stereochemistry studied optically, electric moments, electron diffraction and infra-red spectra. Having established our tools, we are prepared to accept the results that they give, group by group of the periodic table, in the following pages.

So far there is scarcely a mention of electrons ; for example, bonds are polar because some unspecified charge is unsymmetrically distributed. But this is not sufficient ; a theory of valency is needed, and in the next forty pages the electron spin theory is expounded. This involves us in descriptions of atomic *s* and *p* states and *s-p* hybridization. It is all rather condensed ; but everything of importance at this level is included. No wonder that Dr. Palmer claims for these first chapters that "they present a compact but elementary account of classical and modern conceptions of valency . . . not overstraining the capacity of candidates for University examinations of the standard of Part I Natural Sciences Tripos at Cambridge". The claim is fair, though he would need to be a good candidate who really understood some of the quantum theory explanations.

There remain about a hundred pages. These are devoted to a series of special problems, with a distinctly more advanced flavour. It is good to see explained the failure of the octet rule for heavier elements : and even better to see so much space devoted to the method of molecular orbitals. Indeed,

this is one of the very few chemistry text-books where the advantages of the molecular orbital theory are recognized. There is a lot to be said in favour of the theory if we want a simple visual clear-cut explanation of the multiple links of carbon, revealed, for example, in benzene and other aromatic substitutions. There is a final section on hydrogen bonds.

This latter part of the book is obviously more advanced than the first. It is a pity that it is marred by several mistakes. In one or two places the author appears confused in his description of allowed molecular orbitals. All this is probably explained by the present national circumstances, which make the very appearance of the book a matter for congratulation, but the mistakes (the reviewer has found more than half a dozen significant ones) ought to be corrected as soon as possible.

In conclusion, one cannot help comparing this book with Pauling's classical "Nature of the Chemical Bond". Dr. Palmer's historical approach first introduces the electron-pair bond on p. 112 : Pauling introduces it in his first paragraph. The first method is valuable in showing how chemists have thought through their problems to their present knowledge, the second shows how they do think. Pauling has an axe to grind ('resonance, more resonance' is his meat and drink, as they will probably be his last words). But there will be many who will appreciate Palmer's book just because, having no such single idea, he can be fairer to all points of view. Yet this new book lacks the grand scale and manner which have rightly made Pauling's book so famous : "Valency : Classical and Modern" is a sound workmanlike book, but it is not a classic.

C. A. COULSON.

ELECTRICITY IN PEACE AND WAR

Electricity and its Application to Civilian and Military Life

By Charles A. Rinde. Pp. xii+467. (London : George Allen and Unwin, Ltd., 1944.) 25s. net.

THIS book is written round the United States War Department's outline, "Fundamentals of Electricity", and provides a broad foundation for the fields of specialization suggested by the various technical and field manuals. But its use is not confined to war-time applications of electricity. It is recognized that the same basic principles underlie civilian uses of electricity, and both civilian and military applications are stressed throughout.

The central theme unifying the book is the electron and the control of electrons, and quite rationally the electron is first introduced in the chapter on electrostatics, which comes quite early. It is excellent to find more than customary prominence given to the subject of X-rays, for, as the author very rightly says, "the X-ray is no longer merely a means of examining broken bones".

The text is simply written and easy to follow ; it is thus very helpful to those students without previous knowledge of the subject. Many experiments are suggested for the student to carry out, and at the end of each chapter a useful set of questions and problems is provided. There is an abundance of illustrations, and the well-drawn and simple diagrams are a valuable asset to the book which, in spite of war-time conditions, is beautifully produced ; a disadvantage is its rather high price.