

another weakness of the modern world; also that the independent, constructive and, in however modest a degree, creative approach to a subject is the best guarantee that those who have passed through a great scientific school will contribute their full share to the direction and inspiration of industry and public life.

While, therefore, Sir Cyril clearly does not accept much of Dr. Rowe's argument about research and teaching, his address is not a defence of either trivial research or inferior teaching. Rather he calls for teaching of the highest quality, as well as for much independent and critical thinking about methods as well as the content of courses. It may well be that some administrative changes will be needed before ideas such as those outlined by Sir Cyril Hinshelwood and Sir Mark Oliphant are acceptable; further, some changes in the relations between the universities and the schools will be necessary. The changes, however, are not of the kind which Dr. Rowe suggests, and will require much more constructive thought before their shape can be determined. This is one further subject to which attention will no doubt be given when the promised inquiry into higher education is launched; meanwhile, Sir Cyril Hinshelwood and Sir Mark Oliphant have indicated some lines for further thinking and inquiry as well as for profitable experiment.

PAULING'S CHEMICAL BOND

The Nature of the Chemical Bond and the Structure of Molecules and Crystals

An Introduction to Modern Structural Chemistry. By Prof. Linus Pauling. Third edition. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Pp. xx+644. (Ithaca, New York: Cornell University Press; London: Oxford University Press, 1960.) 60s. net.

WHEN the first edition of this book was published in 1939 it was immediately recognized as a classic: for many chemists it became a sort of professional bible. I recall clearly my own sense of breathless astonishment at the scale, the self-confidence, the brilliance and certainty of the author's ideas. For the first time the theory of the chemical bond became a unified and homogeneous, sustained theme. Prof. Pauling rightly received his Nobel Prize for being so largely responsible for this.

Now the third edition is in our hands. It is larger, though many of the older pages survive with little alteration. Inevitably some changes were needed in such matters as bond-energies and bond-lengths, to allow for better experimental information now available. But the author has added new material, notably on his order-length relation for resonating bonds, on his theory of metals (here he has carried almost alone the weight of battle against the physicists), and on the new and interesting electron-deficient compounds (of which the bridged molecule of diborane is the simplest example). We should be grateful for all this, particularly in the discussion of metallic bonding and the metallic radii of atoms. Some of us may even be tempted to smile quietly

at the new pages devoted to the defence of resonance as being no more 'idealistic' than any other theory of chemical bonding. This is a barbed shaft, aimed in a particular direction; and it hits its mark.

There is no doubt but that this new edition will carry the influence of Linus Pauling a stage further. Yet it is impossible—after twenty-two years use of the earlier edition—not to recognize that the book's very success is a pointer to at least one present weakness. For in order to achieve so wonderful a unification of chemistry, Prof. Pauling was almost forced to adopt just one line of description. This is the description first introduced by Heitler and London in 1927, and extended (very largely) by Pauling himself. We call it the familiar valence-bond, or electron-pair, theory. But what he has not done is to provide a really good critique of this theory, or any sufficiently generous reference to the theory's chief rival, the molecular-orbital theory of Hund, Mulliken and Lennard-Jones.

Let me illustrate both of these points. In the first place, very few people who read the pages here devoted to the relation between the dipole moment of a diatomic molecule and the description of its electronic structure in terms of covalent-ionic resonance will gain any idea of the extreme delicacy which attends any calculation or interpretation of molecular dipole moments. An example of the second criticism occurs in the discussion of the new molecular 'sandwich' molecules such as ferrocene. If the valence bond method is adopted, there are no less than 560 structures to be considered. In nickelocene there are 4,100. Pauling starts his account of this latter compound: "With the assumption that the 4,100 structures have equal weight. . .". Some reference really ought to have been made to the fact that in systems like this, and in a large part of the chemistry of inorganic complexes, the molecular-orbital description is vastly simpler, devoid of sweeping assumptions and easier to visualize. There will be many others as well as myself who regret that ligand field theory is dismissed in just over one page.

Yet these limitations in the book are almost inevitable if the author's theme is to remain as grand and monolithic as the structure of the book demands. If the reader can be kept occasionally reminded that there are alternative ways of thinking about the nature of the chemical bond, he can turn to this new "Nature of the Chemical Bond" and experience all the exhilaration and thrill that come from being in the presence of a master of the art of exposition, a man with an immense knowledge of chemistry and passion for it; and whose influence will remain for so long as wave-mechanical ideas continue to provide our best tool for getting to the heart of the structure of molecules and crystals. C. A. COULSON

LEUKÆMIA

Leukæmia

Research and Clinical Practice. By F. G. J. Hayhoe. Pp. viii + 335 + 28 plates. (London: J. and A. Churchill, Ltd., 1960.) 80s. net.

DR. HAYHOE is to be congratulated. His review of one of the widest and most varied fields of practical and experimental medicine is not only remarkably comprehensive but also readable. Each chapter covers a logically delineated region. Difficult questions are not avoided, but a reader