gator will find in this book a wealth of interesting investigative leads.

The book consists of chapters on the transport and metabolism of phospate, on amino acids and glucose, on the tricarboxylic acid cycle in the kidney, on the synthesis and secretion of ammonia, on organic acids and bases, and on phlorizin. All who are interested in normal renal physiology or in such functional alterations induced by disease as renal tubular acidosis, the amino acidurias and the benign glycosurias will find the book rewarding reading. Those interested broadly in bodily function will find it a fascinating and stimulating account of modern trends in renal physiology.

Cornell University Medical College
1300 York Avenue
New York 21, New York
Robert F. Pitts

The Nature of the Chemical Bond and the Structure of Molecules and Crystals: An Introduction to Modern Structural Chemistry. Third Edition. By Linus Pauling, Professor of Chemistry in the California Institute of Technology. Cornell University Press, 124 Roberts Place, Ithaca, New York. 1960. xx + 644 pp. 16 × 24 cm. Price, $8.85.

Immediately after the quantum theory discoveries by Schrödinger and Heisenberg, a number of investigators fruitfully applied the new equations to problems of chemical bonding. But it was the brilliant series of papers on the "Nature of the Chemical Bond" by Linus Pauling that first yielded a synthesis of the new quantum theory with the valence theory built by generations of chemists. The publication of this work in book form in 1939 was a major contribution to the chemical literature. Your reviewer recalls that his first experience in chairing a seminar came immediately therafter; the subject was Professor Pauling's new book.

In the subsequent two decades much has been added to our knowledge of chemical bonding, and it is most appropriate that Professor Pauling has prepared a new edition. This new edition is the third; a second edition was published only one year after the first. The point of view is the same as before; it is a clear and complete presentation of Pauling's own theory. All due credit is given to others who have made contributions which Pauling incorporates into his theory, but there is practically no discussion of alternate theories for the same phenomena. The new text is approximately 150 pages longer and 50 pages of appendices have also been added. Much of the additional space is devoted to discussion of the bonding in substances whose structures have been determined since the earlier editions. Hydrogen bonding in proteins and nucleic acids is such a topic. The discussion of borane structures is completely revised to accord with the new structures. The greatly expanded exposition of Pauling's theory of metallic binding is a particularly valuable addition.

This edition includes a six-page section devoted to rebuttal of the criticism of resonance theory which arose primarily in Russia about a decade ago. While the reply to this largely ill-founded criticism is certainly appropriate, most readers would be more interested in at least an equal space devoted to the comparative merits of well-founded alternate theories which Pauling ignores. For example, overlap integrals provide a semi-quantitative criterion of bond strength which might have been compared with the criterion based upon the maximum angular magnitudes of the orbitals. Recent theories of the orientation of aromatic substituents consider the structure of the transition state in a more definite manner than Pauling does, and a comparison of results of these theories would be of interest.

Pauling states (on page 12) that he prefers to avoid the use of the word mesomerism (introduced by Ingold) because the true structure of a mesomeric or resonating molecule is not just an intermediate between classical bond structures but is a structure further changed in a manner to lower the energy. This reviewer agrees most heartily with the conclusion about structures but has come to the opposite conclusion with respect to terminology. The word, resonance, has a precise meaning in oscillating mechanical and electrical systems which is readily carried into quantum theory but is substantially different from its use in valence theory. Although the etymology of mesomerism may be less than perfect, that word has no other precise scientific meaning and hence has advantage as a name for this essentially unique situation. An example of the difficulties with the valence theory use of the word resonance occurs on page 26 where the usual rule is stated, "resonance can occur only among structures with the same number of unpaired electrons." This unqualified statement is not true because spin-orbit coupling yields small but non-zero exchange integrals between states of different spin orientation and the general meaning of the word resonance applies to just such weakly coupled phenomena as these. Substitution of mesomerism for resonance, however, makes the statement true without qualification.

In the preface to the third edition Professor Pauling indicates that certain changes were made to increase the value of the book to students at relatively early stages in their careers. A word of caution seems required at this point. The two general quantum theories of chemical bonding, based upon molecular orbitals or valence bond orbitals as initial approximations, have comparable merit. The valence bond theory is more readily coupled to classical chemical valence theory as Pauling has most ably demonstrated. But the molecular orbital theory has equally definite advantages in the treatment of the ground state of some systems, the O_2 molecule for example, and is clearly superior for the discussion of excited electronic states. Thus the student's first general study of valence and structural chemistry should include a balanced presentation of both theories. Since the "Nature of the Chemical Bond" contains nothing about the molecular orbital method, except for a few words about H_2, it is more appropriate as a supplementary reference source than as a text for such a study.

This is a book that all chemists interested in the fundamental theory of their subject will wish to have at hand. The book contains a treasure of well selected experimental structural data and would be valuable on that basis alone. The interpretations of these structures, however, are equally important and are always well presented. The only danger is the one mentioned above, that the uninitiated reader may not even become aware of the existence of alternative interpretations.

Department of Chemistry
University of California
Berkeley, California
K. S. Pitzer

Nouveau Traité de Chimie Minérale. Tome XI. **Arsenic-Antimoine-Bismuth.** Edited by Paul Pascal, Membre de l'Institut, Professeur honoraire à la Sorbonne. Masson et Cie., 120, Boulevard Saint-Germain, Paris 6, France. 1958. xxxix + 850 pp. 18 × 25.5 cm. Price: broché, 7.750 fr.; cartonné toile, 8.950 fr.

Nouveau Traité de Chimie Minérale. Tome XIV. **Chrome-Complexed due Chrome-Molybdéne-Tungsténe-Hètèropolyacides.** Edited by Paul Pascal, Membre de l'Institut, Professeur honoraire à la Sorbonne. Masson et Cie., 120, Boulevard Saint-Germain, Paris 6, France. 1959. xxxix + 1014 pp. 18 × 25.5 cm. Price: broché, 9.500 fr.; cartonné toile, 10.700 fr.

The eleventh volume of this classical reference work on Inorganic Chemistry contains chapters on Arsenic by Roger Dolique (403 pages), on Antimony by Pierre Bothorel (162 pages) and on Bismuth by Louis Domange (160 pages). The editor contributes a section on the organic compounds of arsenic (53 pages), but his customary correlating chapter is omitted from this volume. Presumably the correlation will be given in the volume devoted to Nitrogen and Phosphorus.

Volume XIV, on the other hand, follows the more usual pattern beginning with an introductory chapter by Paul Pascal entitled "Group VI sub group chromium, molybdenum, tungsten, uranium, etc." The inclusion of uranium is a sort of vestigial relic of the old Periodic Table but it is retained mainly to emphasize the ways in which it differs from the members of sub-group VI which are the only ones dealt with in the main text. The general chemistry of chromium is described by J. Amiel (389 pages). The complexes of chromium are given a separate treatment by Raymond and Clement Duval (137 pages). A chapter on molybdenum by J. Aubrey (125 pages) and one on tungsten by A. Chretien and W. Freudlich (156 pages) are interlarded with passages on molybdenum oxides and the isopoly and heteropoly acids of molybdenum and tungsten by L. Malaprade (about 162 pages). The order of treatment of topics is part of the set pattern of the series in which the compounds of each element with the elements are taken up starting with group VII and working back to group III. Complexes and organometallics are placed at the end. Thus, Mr. Malaprade's discussion of molybdenum oxides must be taken up between the section dealing with molybdenum compounds of tellurium and the compounds of molybdenum with the elements of group V. The heteropoly acids, on the other hand, may be regarded as complexes and logically belong at the end of the discussion.

The reader would do well to study the organization of the volumes for much of the considerable body of information contained in them is apparent only on thumbing through the pages. The combination of the frustrating French nomenclature and a very inadequate index present a sometimes baffling mystery. It is not clear to this reviewer why the compound acid paraaminophenylarsonique should be listed in the index but acide paraacetylaminophenylantimonique should appear in the index only under the name "Stibazyl" or for that matter "Stibenzyl."

Consistent with other volumes of this edition, volumes IX and XIV give serious attention to the historical development of each topic. Just as much space is devoted to the early unbridled speculations concerning the structure of As_4O_6 as is given to the more modern picture taken from Pauling's "General Chemistry" (1956). And one can find an extensive, if uncritical, discussion on BiO_2 with a bibliography ranging from 1844 to 1953. The major portion of the description is drawn from the early papers. One has the impression from volume IX that the chemistry of arsenic, antimony and bismuth have not been very actively cultivated in recent years. Quite the opposite feeling is derived about the developments in the chemistry of the sixth group transitions metals described in volume XIV. The difference is perhaps a reflection of the interests of the authors. The excellent bibliographies conveniently placed near the discussions make these volumes invaluable additions to the reference shelf.

DEPARTMENT OF CHEMISTRY
THE UNIVERSITY OF CONNECTICUT
STORRS, CONNECTICUT
ROLAND WARD

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June 10, 1960—July 10, 1960

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