

124.5–127.5° [*Anal.* Calcd. for $C_{20}H_{18}O_{13}N_4$: C, 45.98; H, 3.47; N, 10.73; C-CH₃ (1), 2.88. Found: C, 45.83; H, 3.52; N, 10.86; C-CH₃, 3.02]. These data indicate the presence of a 4-formylbutyric acid skeleton in the C-7 acid. The n.m.r. spectrum⁵ of the C-7 acid [(a) -5.84, acidic hydrogen; (b) -3.58, formyl hydrogen; (c) -0.69, C₂ hydrogen; (d) +0.84, C₄ hydrogen; (e) +1.24, singlet, O-methyl hydrogens; (f) +2.68, C₃ hydrogens; (g) +3.33, doublet ($J=6$ cps.), C₆ hydrogens; ratios of areas 1:1:1:3:2:3, respectively] shows that III represents the only compatible manner of methyl and methoxyl substitution on this skeleton.

The structure of the γ -lactone from chalcose was confirmed as II by synthesis. Condensation of diethyl methoxymalonate⁶ with allyl bromide in

(5) Obtained in CDCl₃ solution at 40 mc. Chemical shifts given in parts per million relative to water as 0.

(6) D. E. Ames and R. E. Bowman, *J. Chem. Soc.*, 1079 (1951).

the presence of potassium *t*-butoxide gave diethyl allylmethoxymalonate, b.p. 106° (2.4 mm.), n_D^{25} 1.4362 [*Anal.* Calcd. for $C_{11}H_{18}O_6$: C, 57.38; H, 7.88. Found: C, 57.22; H, 8.07]. The ester was saponified, then treated with 50% sulfuric acid at 100° to give both pairs of diastereoisomers of α -methoxy- γ -valerolactone, one of which [*Anal.* Calcd. for $C_8H_{10}O_3$: C, 55.37; H, 7.75. Found: C, 54.95; H, 7.95] exhibited the same infrared spectrum and vapor phase chromatograms (170°) as the lactone from chalcose.

The structure of chalcose is thus proved to be Ia, a formulation which also has been confirmed by its n.m.r. spectrum.⁷

(7) Determined in CDCl₃ solution at 60 mc. by L. F. Johnson, Varian Associates.

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BOOK REVIEWS

Toxic Phosphorus Esters. Chemistry, Metabolism, and Biological Effects. By RICHARD D. O'BRIEN, formerly Pesticide Research Institute, Canada Department of Agriculture, London, Ontario, and now Associate Professor of Insecticide Chemistry, New York State College of Agriculture, Cornell University, Ithaca, New York. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1960. xii + 434 pp. 16 × 23.5 cm. Price, \$14.50.

Since World War II, organophosphates with their extraordinary biological activity as inhibitors of cholinesterase have opened up a very rich and important field of investigation. The toxic phosphorus esters include the so-called "nerve gases," tabun, sarin and soman, but more significantly, the discovery of these toxic warfare agents led to the further discovery and development of extremely useful insecticides which are used now on a world-wide basis. Some of these insecticides possess systemic properties, *i.e.*, they penetrate the host plant or animal to kill the insects or arthropods attacking the host. Some of the toxic phosphates turned out to be excellent tools for the investigation of certain esterase enzymes, and this had led to new basic knowledge in enzyme chemistry. The author tells this absorbing story and tells it very well indeed. But his text is nonetheless disciplined, well indexed, and outstanding in the completeness of references which he gives at the end of each chapter. The reader can find what he is looking for.

The opening chapter outlines the plan of the book, the history of phosphorus esters, a brief exposition of the nomenclature of these compounds, with a sketch of what is known about cholinesterase and its biological significance. Chapter 2, entitled "Nonenzymic Reactions," describes the hydrolysis, isomerization, transalkylation, oxidation (sulfides to sulfoxides or sulfones, replacement of sulfur by oxygen), dehydrochlorination and effects of light on phosphates. Chapter 3 brings the phosphates into reaction with cholinesterase *in vitro* and describes the kinetics of this reaction and what is known about the relationship between the structure of the inhibitor and anticholinesterase activity. There is also a discussion on the reversal of inhibition and

selective inhibition between true and pseudocholinesterase. Chapter 4 tells of enzyme reactions *in vitro* which either enhance or reduce the reactivity of the inhibitor. Chapter 5 describes inhibitor effects on nerve and muscle tissue, especially as they relate to mechanisms of nerve transmission. Chapter 6 gives a very good comprehensive treatment of the effects in mammals of poisoning, and it includes the counter-effects of atropine and of 2-PAM and other oximes which can be used as prophylactics or as antidotes. Also included in this chapter is a brief account of synergism or potentiation of certain phosphates, as well as the metabolism in intact animals of Co-Ral, diazinon, Delnav, dimethoate, Dipterex, malathion, parathion, Phosdrin, ronnel and Systox. Chapter 7 describes the effects of phosphate inhibitors in insects, ovicidal action, differential toxicity. It includes a brief summary of insect resistance to phosphates with a description of what is known about mechanisms of resistance. Chapter 8 gives an account of systemic effects of phosphates in plants and their metabolism. Chapter 9 carries the intriguing title "Selective Toxicity." If the synthesis chemist knew much about this subject, he could design compounds to kill harmful species of pests which would be perfectly safe to man and his livestock. This chapter necessarily contains much that is speculative; it also has some stimulating ideas and some solid data in it. Chapter 10 closes with an outline of some useful techniques which are especially appropriate to working with phosphates in the laboratory. An appendix includes a brief treatment of electronic effects which influence polarity, acidity and basicity of molecules. Included is a useful list of toxic phosphates (mostly insecticides or acaricides) giving the structure, common name and manufacturer.

This book is full of up-to-date information, and it is written in a very fine straightforward style. It is definitely a book to have if you are concerned at all with this important field of interest.

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