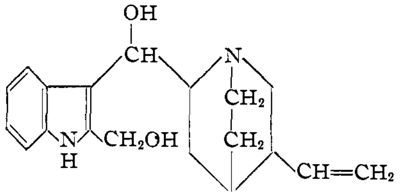
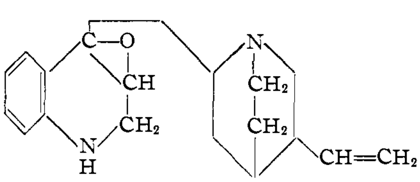
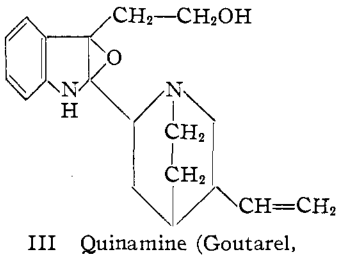


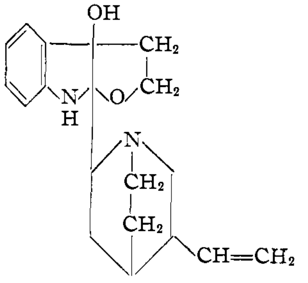
I Quinamine (Kirby 1945)



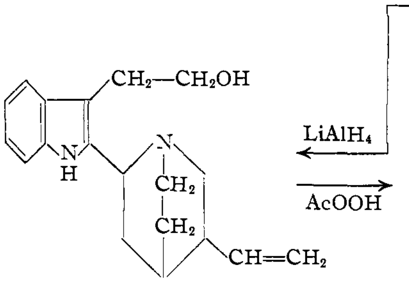
II Quinamine (Robinson, 1949)



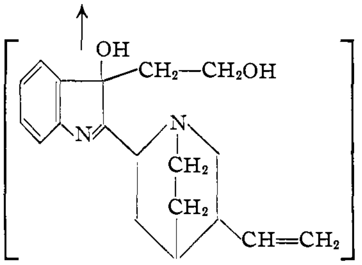
III Quinamine (Goutarel, Janot, Prelog, Taylor, 1950)



IV Quinamine



V Cinchonamine (Goutarel, Janot, Prelog, Taylor, 1950)



VI

nal addition of the β-hydroxyethyl chain to the reactive —C═N— double bond in VI leads to quinamine (IV). Further oxidation of the latter with rupture of the indole ring, which is usually observed under similar conditions, cannot occur. The removal of the hydroxyl group in IV by the action of lithium aluminum hydride[5] is analogous to the similar conversion[7,8] of 11-hydroxytetrahydrocarbazolenine[9] to tetrahydrocarbazole; opening of the oxide ring and loss of water results in cinchonamine (V).[5]

The quinamine (IV), obtained from 50 mg. of cinchonamine with peracetic acid in good yield, formed silky needles, m. p. 171–173°; calcd. for $C_{19}H_{24}N_2O_2$: C, 73.0; H, 7.77. Found: C, 72.83; H, 8.04. Comparison with an authentic specimen with regard to mixed melting point and ultraviolet and infrared absorption spectra confirmed the identity. Whether a second compound obtained in small yield as colorless cubes from ether, m. p. 143–145°, possibly isomeric with quinamine, has the other configuration at the β-indole position and is related to conquinamine[10] has not yet been established.

11-Hydroxytetrahydrocarbazolenine, under the action of alcoholic alkali, rearranges to *spiro*-[cyclopentane-1,2′-ψ-indoxyl].[9] Quinamine, under similar conditions, forms the yellow isoquinamine[3] which is, as Sir Robert Robinson and Dr. Prelog independently concluded, clearly an indoxyl derivative: ultraviolet spectrum, $\lambda\lambda$ max. (log ϵ): 228 mμ (4.427); 398 mμ (3.513); $\lambda\lambda$ min. (log ϵ): 250 mμ (3.985); 287 mμ (2.888). Infrared spectrum: 5.88 μ (carbonyl of five-membered ring), 6.18μ (Ph—NH—C—(R_1R_2)—). Reduction with lithium aluminum hydride furnishes *allo*dihydroisoquinamine, colorless needles, m. p. 172–174°. Attempts to convert this compound to cinchonamine (V) by an acid-catalyzed Wagner–Meerwein rearrangement[11] are in progress.

The conclusions as to the structure of quinamine were also reached independently by Prof. Prelog after he had been informed of the relevant facts summarized briefly above.

Acknowledgment.—I am indebted to Dr. Raymond-Hamet (Paris) for a sample of cinchonamine. Dr. Prelog (Zürich), as well as Drs. Sharp and Shaw (The Wellcome Laboratories of Tropical Medicine, London), through the courtesy of Dr. T. A. Henry, kindly placed at my disposal two samples of quinamine.

[7] Witkop and Patrick, some novel aspects of the chemistry of β-hydroxindolenines, *Experientia*, in press.

[8] Witkop and Patrick, THIS JOURNAL, in preparation.

[9] Patrick and Witkop, *ibid.*, **72**, 633 (1950).

[10] Hesse, *Ann.*, **209**, 62 (1881).

[11] *Cf.* Witkop, THIS JOURNAL, **72**, 614 (1950).

CONVERSE MEMORIAL LABORATORY
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RECEIVED MARCH 6, 1950

OROTIC ACID, A GROWTH FACTOR FOR *LACTOBACILLUS BULGARICUS*

Sirs:

Certain strains of *Lactobacillus bulgaricus* grow readily on a synthetic medium containing yeast extract as the source of an unknown nutritive essential (LBF).[1] We have found that other strains of the same species are incapable of growth on such a medium and require much larger amounts of natural material to furnish another growth factor(s). Using one such strain identified

[1] Williams, Hoff-Jorgensen and Snell, *J. Biol. Chem.*, **177**, 933 (1949).

as *Lactobacillus bulgaricus* 09 (Cornell collection) and a basal medium[2] fortified with (per tube): vitamin B_{12} 10 mγ, and yeast extract 10 mg., the distribution and properties of the factor(s) have been determined. Whey was found to be a very good source of the growth promoting substance. As it occurs in dried whey the factor is dialyzable, soluble in water, and insoluble in organic solvents. It is adsorbed from acidic aqueous solution by carbon, superfiltrol, Fuller's earth, and IR-A 400. It is eluted from super filtrol and Fuller's earth with difficulty. The factor is extractable by butanol from acidic but not from neutral or alkaline aqueous solution.

In a survey of known compounds, orotic acid (4-carboxyuracil) (10 to 100γ per tube) was found to replace the requirement of the organism for large amounts of natural material. For this particular strain, in the presence of adequate amounts of orotic acid, maximal growth is obtained even in the absence of yeast extract from the medium.

Inactive compounds include uracil, uridine, uridylic acid, cytosine, cytidylic acid, uric acid, asparagine, aspartic acid, lactose, urea, alloxan, allantoin, thymine, γ-aminobutyric acid, 5-carboxyuracil, 4-methyluracil, and 2-amino-4-methyl-6-hydroxypyrimidine.

The factor, as it occurs in milk products, like orotic acid, is stable to autoclaving at 120° for one hour with 3 N acid. The activity as encountered in other sources such as Wilson's liver faction "L," corn steep solids, and dried distillers solubles is reduced markedly by such treatment suggesting the occurrence of a more highly active derivative of orotic acid.

Orotic acid and 4-carboxyuridine have been suggested[3] as precursors in the biosynthesis of uridine and/or cytidine, and 4-carboxyuridine or some such related derivative of orotic acid very well may be the uncharacterized acid-labile component of natural materials.

(2) Skeggs, Huff, Wright and Bosshardt, *J. Biol. Chem.*, **176**, 1459 (1948).

(3) Arvidson, Eliasson, Hammarsten, Reichard, Von Ubisch and Bergstrom, *ibid.*, **179**, 169 (1949).

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RECEIVED APRIL 7, 1950

BOOK REVIEWS

Artificial Radioactivity. By P. B. MOON, F.R.S., Professor of Physics in the University of Birmingham. (Cambridge Monographs on Physics. General Editors: N. Feather and D. Shoenberg.) Cambridge University Press, (American Branch), 51 Madison Avenue, New York 10, N. Y. 1949. 102 pp. 13.5 × 21.5 cm. Price, $2.50.

This little book should be of real interest to radiochemists and nuclear physicists because of its careful and thoughtful treatment of a selected list of topics in the field of artificial radioactivity. It does not attempt an exhaustive treatment; for example, there is no extensive isotope table. It does, however, discuss such subjects as the nature of beta radioactivity and orbital capture processes in very considerable detail. Its presentation of the theory of beta radioactivity is excellent, and its tables and charts assist one in making theoretical calculations of the Fermi function for a given beta emitter. The most useful of these is Figure 12 on page 47, which is a log plot of the Fermi function *versus* the energy of transition for elements of different atomic numbers and the two signs of the beta particles. The chapter on measurement technique is adequate, though not exhaustive. Chapter IV on radioactive processes in which Z does not change is useful in acquainting general workers in the field of radioactivity with the rapid advances made in the technique of establishing decay schemes for gamma ray transitions.

One error of fact apparently occurs in a number of places in the book. This is the half life of K^{40}, which seems now to have returned to the older value of 1.4 billion years as contrasted to the smaller value of approximately 0.4 billion years used by Dr. Moon, which was popular a few months ago. In addition, a few errors of omission occur due to the fact that this book deals with subjects in such a rapidly moving field. In several cases the latest data are not given.

W. F. LIBBY

Monomers. A Collection of Data and Procedures on the Basic Materials for the Synthesis of Fibers, Plastics, and Rubbers. Edited by E. R. BLOUT, Chemical Research Laboratory, Polaroid Corporation, Cambridge, Massachusetts, and W. P. HOHENSTEIN and H. MARK, Institute of Polymer Research, Polytechnic Institute of Brooklyn, Brooklyn, New York. Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, N. Y. 1949. 339 pp. Illustrated. 18.5 × 25.5 cm. Price, $7.50.

The "book" consists of a loose-leaf binder containing individually stapled pamphlets on each of the following monomers: acrylonitrile (37 pages), butadiene (45 pages), isobutylene (32 pages) isoprene (37 pages), methyl methacrylate (36 pages), styrene (63 pages), vinyl acetate (55 pages) and vinyl chloride (32 pages). Sections on acrylic acid, esters of acrylic acid and on esters of methacrylic acid other than methyl methacrylate are reported to be in active preparation. The information on each monomer is presented under the general headings of Production (laboratory and industrial), Purification and Analysis, Care and Handling, Physical Properties, Chemical Reactions, Polymerization and Bibliography.

The methods given for the laboratory preparation of the monomers appear to be generally adaptable to ordinary laboratory conditions. The discussions of industrial methods of preparation include, in some cases, methods