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THE RENAL REGULATION OF ACID BASE BALANCE WITH SPECIAL REFERENCE TO THE MECHANISM FOR ACIDIFYING THE URINE[1]

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LARGE quantities of acid are continuously produced in the body by the metabolism of the various foodstuffs, yet in health the hydrogen ion concentration of the body fluids is maintained remarkably constant. This regulation of balance between the acidic and basic constituents of the body fluids is dependent upon both respiratory and renal homeostatic mechanisms. In a quantitative sense the rate of production of carbonic acid, amounting to about 20 mols per day, far exceeds the rate of production of other metabolic acids. But because of the volatility of its anhydride, carbon dioxide, carbonic acid is readily and rapidly eliminated by the lungs. Less than one one-hundredth of this quantity of phosphoric and sulfuric acid is produced each day, yet the excretion of these acids, which is effected largely by the kidneys, is in some ways a greater problem than is the excretion of the much larger quantities of carbonic acid. Rarely does any disease process lead to a disturbance of acid base balance because it interferes with the elimination of carbon dioxide in the lungs.

[1] Presented as an Abraham Flexner Lecture at Vanderbilt University School of Medicine on April 20, 1945, and as a Lecture in Medicine at the University of Utah School of Medicine on May 18, 1945.

of glutamic acid was accomplished with levulinic acid as starting material? In the account of Hedin's procedure for the isolation of histidine, no reference is made to the fact that the silver salt is precipitated in one of the steps, nor are the conditions of this precipitation indicated. And an uninformed reader could gain little from the statement that Harington, in his work on thyroxine, "subjected his crystalline product to dismutation and identified each fraction."

The story of the discovery of tryptophane is misleading in one respect, apparently owing to the misinterpretation of a passage, paraphrased from a review article by Vickery and Schmitt, to the effect that as a result of Kühne's researches "indole and tryptophane very early became associated with each other." The identification of indole as a product of the putrefaction of proteins was accomplished by Nencki, and not by Kühne.

In the second chapter, on proteins, accuracy and lucidity are too often sacrificed to impressiveness of utterance. For example, it is here stated that "Those substances that are contained in or produced by bacteria and that engender the production of specific immune bodies are likewise proteins"; the reader has to traverse more than 100 pages before encountering the more correct statement that "many antigens are proteins and most proteins are antigens." In the discussion of amino acids as dipolar ions an unsuspecting student would have difficulty in interpreting the dissociation curves (p. 70) in which zero percentage dissociation is attributed to amino acids in the intermediate zones of pH.

On the other hand, the third chapter, on protein structure, is an admirable exposition of a difficult subject; clearly expressed, logical and well balanced.

Chapter IV, on the hydrolysis of proteins, abounds in detailed, but poorly integrated, information. It also contains obscure passages such as "Some hydrochloric acid is lost during boiling. Alkalies . . . absorb carbon dioxide . . . . Therefore, if one wishes to perform accurate hydrolysis and be in a position to duplicate his own results, it is necessary to express the concentration of acids and alkalies in terms of normality," and is not free of errors like ". . . the ratio $\frac{\alpha\text{-amino N}}{\text{total N}}$ is 100."

The fifth chapter, on the synthesis and isolation of certain amino acids, is more elaborate in treatment than the third, but equally meritorious. It is obviously addressed to advanced students, and shows care in the accentuation of principles and the avoidance of unessential detail.

In the next chapter, on methods of analysis for amino acids and proteins, the treatment in some, but not all, sections approaches that of a manual of analysis; the information here supplied could be of practical value only in conjunction with that obtainable from a standard work like that of Hawk and Bergeim. This chapter concludes with a very brief statement, without theoretical explanation, of the electrophoretic procedure of Tiselius for the separation of plasma proteins, a section on "protein levels in health and disease" and some semi-detailed accounts of analytical methods for the determination of serum proteins.

An excellent, though brief, review of the role of amino acids in immunochemistry, addressed to the trained biochemist, is followed by an equally authoritative essay on amino acids in detoxication, the subject-matter for which is carefully selected, informative and thoughtfully discussed. The organic chemist will accept with some reserve the inferences drawn from the results of physiological balance experiments, which are often open to more than one interpretation. The biochemist sometimes yields, for the sake of simplicity, to the temptation to ascribe only one of several possible courses to a series of metabolic conversions. For example, it is here unequivocally stated that in the formation of a mercapturic acid the acetylation takes place subsequently to the combination of the aromatic group with the sulfur atom. This is no doubt probable, but has not been proved.

The chapters on the metabolism of proteins and amino acids and on the intermediary metabolism of individual amino acids are among the best in the book, and will well repay study by biochemist and organic chemist alike. The very short account of nitrogen equilibrium and the biological value of proteins serves as a stimulating introduction to the subject of the final chapter, amino acids and proteins in nutrition, the presentation of which is conscientious but rather lacking in chemical imagination. This failing is perhaps attributable to the magnitude of the load of published matter which the review has to bear.

An appendix contains a list of titles of U. S. patents issued on amino acids and related organic compounds.

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BOOKS RECEIVED

ALTENBURG, EDGAR. *Genetics.* Illustrated. Pp. xii + 452. Henry Holt and Company. $3.20. 1945.

BURK, R. E. and OLIVER GRUMMITT, Editors. *Advances in Nuclear Chemistry and Theoretical Organic Chemistry.* Illustrated. Pp. 165. Interscience Publishers. $3.50. 1945.

HOSKINS, MARGARET M. and GERRIT BEVELANDER. *Essentials of Histology.* Illustrated. Pp. 240. C. V. Mosby Company. 1945.

KAPLAN, OSCAR J., Editor. *Mental Disorders in Later Life.* Illustrated. Pp. vii + 436. Stanford University Press. $5.00. 1945.

MUKERJEE, RADHAKAMAL. *Social Ecology.* Pp. xvi + 364. Longmans, Green & Company, Bombay. Rs. 10/8.