

the species is a "practical device," a necessary conception for reducing the endless variety of forms to some system; for the student of evolution it is merely a "passing stage in the stream of evolution." He wishes to know how it came into being and whither it leads.

But for both a definition is desired, but it can only be approximate and must be regarded as a convenience of varying value. As yet it is quite impossible to define "species," for the definition depends upon the degree of our knowledge of the group, but he endeavors to reach it by framing definitions of the "practical species concept," the "morphological concept," the "genetic species concept," the "concept based on sterility" and the "biolo-species definition." From all these we emerge with the definition: "Species are groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups." Accordingly the test is purely physiological, despite the author's choice of a morphological one. As to the method of origin of a new species it is stated as follows: "A new species develops if a population which has become geographically isolated from its parental species acquires during the period of isolation characters which promote or guarantee reproductive isolation when the external barriers break down." There must therefore exist all degrees of speciation, in which final separation into definite groups is at length attained. A discussion of this question occupies Chapter VII, and non-geographic speciation the following one, with biology of the process forming the substance of the third. We come then to a discussion of the higher categories in evolution, of which the genus is typical. Mayr quotes Thorpe, who defines the genus thus: "A genus is a systematic unit including one species or a group of species of presumably common phylogenetic origin, separated by a decided gap from similar groups." The recognition of this assemblage is regarded as a purely subjective affair, there being no real limits. The book finally ends with a discussion of macro- and micro-evolution factors, where the author reaches the conclusion that "all the available evidence indicates that the origin of the higher categories is a practice which is nothing but an extrapolation of speciation. All the processes and phenomena of macroevolution and the origin of the higher categories can be traced back to intraspecific variation, even though the first steps of such processes are usually very minute."

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VOLUMETRIC ANALYSIS

Volumetric Analysis, Vol. I. I. M. KOLTHOFF and V. A. STENGER. Second revised edition. xv + 309

pp. 31 figs. 15 × 23 cm. New York: Interscience Publishers, Inc. 1942. \$4.50.

THIS book is the first of a two-volume set covering the field of volumetric analysis. In revision, it closely follows the organization of the earlier German edition and its English translation. Volume I deals with theoretical principles, and Volume II, now in preparation, is to consider practical principles.

The book capably deals with the underlying theory of acid-base neutralization, oxidation-reduction, complex-formation and precipitation as related to volumetric analysis. In addition, there are general chapters which discuss titration errors, induced reactions, catalysis, mixed crystal formation and coprecipitation, indicators, organic analysis and physical methods of finding the equivalence point. In the revised edition, a large amount of new material has been added to the discussion of redox indicators; and a section has been added covering the rather new field of amperometric or polarimetric titrations. The chapter on organic volumetric methods has been extensively revised; however, it does little more than exemplify the application of the general theory of volumetric analysis to a few typical problems arising in the organic field. Throughout the book new references have been added, and the appendix has been changed to include new data and to take into consideration the activity principle.

The physical make-up of the book is good. The print is large and easy to read, and the binding is attractive.

The volume is highly recommended to any one interested in volumetric analysis, and should be considered an indispensable part of the library of those engaged in the development or improvement of volumetric methods.

QUANTITATIVE ANALYSIS

Analytical Chemistry, Vol. II, Quantitative Analysis.

F. P. TREADWELL and W. T. HALL. Ninth English edition. xi + 806 pp. 121 figs. 15 × 23 cm. New York: John Wiley and Sons. 1942. \$6.00.

THIS, the quantitative volume of a two-volume set, describes in detail well-known gravimetric and volumetric methods for the ions and common methods of gas analysis.

In this ninth edition, the scope of the book is unchanged from previous editions. In many cases, newer well-tried methods have replaced older ones, and the older methods have been brought up to date.

There has been a significant change in the make-up and arrangement of the book. The sections on gravimetric, volumetric and gas analysis have been divided into chapters, and the section of tables has been enlarged and brought up to date. The chapters in

the gravimetric section correspond to the ion groups of the ordinary scheme of qualitative analysis. The volumetric section is divided according to type of reaction, such as oxidation-reduction, acid-base neu-

tralization, and others. This new arrangement makes for a much more attractive and useful volume.

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SPECIAL ARTICLES

THE ROLE OF "FOLIC ACID" AND BIOTIN IN THE UTILIZATION OF PANTOTHENIC ACID BY THE RAT

THE inclusion, in *highly purified diets* fed to rats, of sulfaguanidine or of succinylsulfathiazole brings about a retardation of growth; after growth ceases the animals lose weight and usually die within a few weeks. The effect of these drugs has been attributed to their interference with the synthesis of essential factors by intestinal bacteria.¹ This explanation is supported by the fact that sulfaguanidine is partially retained in the intestine,^{2,3} while about 95 per cent. of ingested succinylsulfathiazole fails to be absorbed from the alimentary tract.^{4,5} Recently Nielsen and Elvehjem,⁶ using succinylsulfathiazole, reported that supplementation with biotin and concentrates of "folic acid" caused a striking resumption in growth which was maintained during several weeks therapy. Martin,⁷ who used sulfaguanidine, obtained similar results. We⁸ have presented detailed evidence in confirmation of the findings of Nielsen and Elvehjem.

In addition to the cessation of growth, rats fed the sulfonamide in purified diets⁹ frequently develop signs of marked pantothenic acid (PA) deficiency, such as achromotrichia and porphyrin-caked whiskers.⁸ The fact that "folic acid" (biotin was also present) will cure the achromotrichia produced by sulfaguanidine feeding was attributed by Martin⁷ to a chromotrichial action of this factor.

We have found that the signs of PA deficiency in rats are borne out by microbiological assays of the PA content of the liver.¹⁰ Liver obtained from rats

on a complete diet¹¹ or on the highly purified diet without sulfonamide contained 80–90 μ gm of PA per gram. Rats fed the purified diet, without either PA or succinylsulfathiazole, developed signs of severe PA deficiency, and the liver tissue contained only 40–50 μ gm of PA per gram. Rats fed the purified diet with succinylsulfathiazole (2 per cent.) showed marked evidence of PA deficiency, despite the presence in the diet of adequate amounts of PA (4 mgm per 100 gm), and the PA content of the liver was reduced to only 40–50 μ gm per gram. Further increase in the PA content of the diet (10 mgm per 100 gm) caused no favorable effect. Administration of PA subcutaneously, 200 μ gm daily, also was without influence on the diminished content of PA in the liver or on the severely depressed rate of growth.

When the purified diet was supplemented with succinylsulfathiazole (2 per cent.) and dried grass¹² (5 per cent.) the PA content of the liver was raised to a value (50–70 μ gm per gram) intermediate between normal levels and those produced by the basal diet with added sulfonamide. However, this moderate increase in liver PA content was accompanied by a growth rate comparable to that of rats on the basal diet.

The oral administration of crystalline biotin¹³ (5 μ gm daily) for a period of 3 weeks caused a slight increase in the PA content of the liver and some improvement in the rate of growth of the succinylsulfathiazole-fed rats. When, however, in addition to biotin (5 μ gm), a "folic acid" concentrate¹⁴ (20 mgm

¹ S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exper. Biol. Med.*, 47: 308, 1941.

² E. K. Marshall, Jr., A. C. Bratton, L. B. Edwards and E. Walker, *Bull. Johns Hopkins Hosp.*, 68: 94, 1941.

³ W. M. Firor and E. J. Poth, *Annals of Surg.*, 114: 663, 1941.

⁴ E. J. Poth and F. L. Knotts, *Proc. Soc. Exper. Biol. Med.*, 48: 129, 1941.

⁵ A. D. Welch, P. A. Mattis and A. R. Latven, *Jour. Pharmacol. and Exper. Therap.*, 75: 231, 1942.

⁶ E. Nielsen and C. A. Elvehjem, *Jour. Biol. Chem.*, 145: 713, 1942.

⁷ G. J. Martin, *Proc. Soc. Exper. Biol. Med.*, 51: 353, 1942.

⁸ A. D. Welch and L. D. Wright, *Jour. Nutrition*, in press.

⁹ Composition of diet: casein (Labco) 18 gm, fat (Primex) 10 gm, corn oil 2 gm, sucrose 61.9 gm, salts 4 gm, cellulose flour 4 gm, vitamins A, D and E concentrate 0.08 gm, choline chloride 0.1 gm, thiamine hydrochloride 0.2 mgm, riboflavin 0.4 mgm, pyridoxine hydrochloride 0.2 mgm, nicotinic acid 4 mgm, calcium pantothenate 4.4 mgm, p-aminobenzoic acid 4 mgm, inositol 8 mgm, 2-methyl-1,4-naphthohydroquinone diacetate 1 mg.

¹⁰ Some of the liver samples were prepared for assay after autolysis as described by L. D. Wright, *et al.*, University of Texas Publication, 4137: 38, 1941. We now employ enzyme digestion of the liver samples with taka-diastase, as recommended by V. H. Cheldelin, *et al.*, University of Texas Publication 4237: 15, 1942. With liver samples autolysis liberates approximately 90 per cent. of the pantothenic acid found after enzyme treatment. Pantothenic acid was determined by either the method of D. Pennington, *et al.*, *Jour. Biol. Chem.*, 135: 213, 1940, or the method of M. Landy and D. M. Dicken, *Jour. Lab. and Clin. Med.*, 27: 1086, 1942.

¹¹ Purina chow.

¹² Powdered grass ("Cerophyl") was generously supplied by Dr. Richard Graham, of the Cerophyl Laboratories, Kansas City, Mo.

¹³ We are indebted to Dr. Hans Molitor, Merck Institute for Therapeutic Research, and Dr. W. H. Engels, Research Laboratories, Merck and Company, for a generous gift of crystalline biotin.

¹⁴ Prepared from "Cerophyl" by the procedure described by B. L. Hutchings, N. Bohonos and W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941. This concentrate contained approximately 800,000 Snell-Peterson units of "folic acid" per gram.