24 hours. Nine volumes of absolute ethanol was added slowly with stirring to the cooled reaction mixture to yield a white precipitate, which, after being washed successively with absolute ethanol and ether, was dissolved in a minimal amount of water and brought to about *p*H 6 with concentrated ammonia. The mixture was applied to the top of an Amberlite XE-64 (a fine mesh, weak cation exchange resin) column in the washed free acid form. The effluent fractions from the column, on elution with water, were examined spectrophotometrically and by paper chromatography.[7] Two components, one of which was very small, gave positive ninhydrin tests. The major and slower moving of these, which showed a maximum absorption at 3250 Å., was concentrated *in vacuo* to a white residue which upon treatment with a small amount of water soon became crystalline. The product was sparingly soluble in water and was recrystallized by the addition of an equal volume of ethanol to the aqueous solution. The crystals appeared as systems of rhombic plates.

Anal. Calcd. for $C_8H_{13}N_2O_5P \cdot 2H_2O$: C, 33.8; H, 6.0; N, 9.9; P, 10.9. Found: C, 34.1; H, 5.9; N, 10.2; P, 11.1. When dried *in vacuo* (P_2O_5), the compound lost the theoretical amount of weight.

Ultraviolet absorption in 0.01 *M* buffers: $\lambda_{max.}$ (*p*H 2.0) 2935 Å., E_m 9600; $\lambda_{max.}$ (*p*H 7.2) 2535 Å., E_m 5200, 3265 Å., E_m 9400; $\lambda_{max.}$ (*p*H 10.0) 2440 Å., E_m 7500, 3120 Å., E_m 8300.

The crystalline pyridoxamine phosphate was oxidized with MnO_2[2] yielding NH_3 stoichiometrically. The oxidized preparation (pyridoxal phosphate) exhibited a high order of catalytic activity in a transaminase system of *Lactobacillus arabinosus*,[8] the tyrosine decarboxylase system of *Streptococcus faecalis*,[9] the aspartic acid β-decarboxylase system of *Clostridium welchii*,[10] and the tryptophanase system of *Escherichia coli*.[11] Within experimental error, the determination of relative purity yielded values of 100% based on assay with the tyrosine decarboxylase system[9] and by comparison with an impure preparation of pyridoxal phosphate assayed in another laboratory.[12] Assay of the crystalline pyridoxamine phosphate as described by Hendlin, *et al.*,[13] yielded similar results.

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RECEIVED DECEMBER 1, 1951

(7) Pyridoxamine and pyridoxamine phosphate were detected by the orange color formed after reaction with ninhydrin.

(8) A. Meister, *Federation Proceedings*, **10**, 223 (1951).

(9) W. W. Umbreit, W. D. Bellamy and I. C. Gunsalus, *Arch. Biochem.*, **7**, 185 (1946).

(10) A. Meister, H. A. Sober and S. V. Tice, *J. Biol. Chem.*, **189**, 577 (1951).

(11) W. A. Wood, I. C. Gunsalus and W. W. Umbreit, *J. Biol. Chem.*, **170**, 313 (1947).

(12) This preparation was generously provided by Dr. W. W. Umbreit.

(13) D. Hendlin, M. C. Caswell, V. J. Peters and T. R. Wood, *J. Biol. Chem.*, **186**, 647 (1950).

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BOOK REVIEWS

Progress in Chromatography 1938–1947. By L. ZECHMEISTER, California Institute of Technology, Pasadena, California. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1951. xviii + 368 pp. 14 × 22 cm. Price, $8.00.

Professor L. Zechmeister, well known as a superb experimentalist both before and after his migration from Hungary to the California Institute of Technology, performed a distinct service to the science by writing, with L. Cholnoky, the authoritative "Principles and Practice of Chromatography," published in 1941 as a translation of a second German edition of the original work.

In the present volume Professor Zechmeister has presented a progress report consisting of a survey of the literature on the technique and application of chromatography in the period 1938–1947. The field is currently expanding and developing at so rapid a pace that the author felt that at this time a supplement would be more appropriate than a revision of the original monograph. He has thus presented a meticulously prepared survey of literature on principles and methods of chromatography, and on specific applications.

The 57-page survey of advances in the principles and methodology is a worthy extension of the original book as far as it goes, but the long gap between literature coverage (through 1947) and publication (1950) is hardly excusable in a book dealing with this rapidly developing and enormously useful technique. Thus partition chromatography, particularly as applied in the paper strip method, has become so familiar a tool that the papers of 1941–1947 now seem like early history.

The major part of the book is devoted to a review of the literature on specific applications of chromatography to organic compounds of some twenty structural types and to inorganic compounds. In the preface, the author states that "even hints about methods, adsorbents or solvents which can be used within a certain class of compounds may be welcome and time-saving for the experimenter." The objective is worthy, and perhaps the plan of citing applications classified according to type of compound was the best expedient for this interim work. However, the citation of chromatographic experiences and accomplishments in various fields seems to me to fall somewhat short of the mark. One working in a given field will soon learn from the specific literature the methods of chromatography traditionally used for the class of compounds concerned and might derive more stimulation from a cross-sectional discussion that perhaps would suggest trial of methods found useful for separation of compounds of other types. Chromatographic processing of reaction mixtures and mother liquors by the empirical elution technique is now practiced in many laboratories so frequently—to an extent at least comparable to

fractional crystallization—that the past plan of citing all known applications of chromatography probably will have to be abandoned in future editions. A corresponding expansion of Professor Zechmeister's expert and critical comments on principles and methodology would be highly welcome.

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Advances in Enzymology and Related Subjects of Biochemistry. Volume XI. Edited by F. F. NORD, Fordham University, New York, N. Y. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. viii + 471 pp. 16.5 × 23.5 cm. Price, $9.00.

The present volume contains reviews of varied scope and quality. Those written in the nature of a genuine review will be of interest to most biochemists; others, which are expansive treatments of some very limited topic, will appeal mainly to specialists in the particular field. The first article, "The nature of entropy and its role in biochemical processes" by H. Gutfreund, covers most certainly a problem of general dimension. The extent to which it will clarify the problem to biochemists at large is however problematic, although the author keenly appreciates the intricacies of biological phenomena. For those unfamiliar with thermodynamics the presentation is likely to prove difficult, especially since both entropy and partial molal quantities are introduced in mathematical form. To those, on the other hand, who have a substantial background in thermodynamics the treatment will present no difficulty but much of the discussion may appear superfluous. Specific biological phenomena are approached gingerly—and rightly so. Even in the case of muscular contraction the author equivocally concludes, "So we can summarize by saying that entropy changes can be responsible for contractile mechanisms." "Reactions at interfaces in relation to biological problems" by J. F. Danielli and J. T. Davies constitutes a fairly complete discussion of the writers' and allied workers' experiments on various surface phenomena. Differences in degree of ionization between bulk and surface phases, the influence of surface pressure, temperature and stereochemical configuration are among the topics included. The enthusiasm of the authors for the importance of the interface in biological phenomena is made evident in the introductory paragraphs. It is nevertheless apparent that the immediate application of these studies to biological phenomena is less decisive than might be wished for. One wonders at the value of a statement such as ". . . the combination of heme and globin to give hemoglobin. . . is likely to be based on processes essentially similar to those involved in complex formation in monolayers." "Chlorophyll fluorescence and photosynthesis" by E. C. Wassink is a very extensive review of the various attempts to detail a connection between these two related phenomena. Since both are incompletely understood experiments aimed at explaining a relation between them lend themselves to alternate interpretations—and of this the author is well aware. The polemical manner of writing adds vivacity to the reading, but for one not specifically concerned with the problem the exhaustive presentation of data is bound to prove over-bearing. "Thiol groups of biological importance" by E. S. G. Barron is an excellent and comprehensive review of biologically active thiols in low molecular weight solutes and in proteins. The subject is first treated from the standpoint of thiol oxidation. Metallic ions are then considered in terms of chemical combination with –SH and in relation to oxidation. The thiols of proteins are approached largely from the aspect of protein denaturation, and their more immediate significance to biological activity is considered in relation to actomyosin formation and to those enzymes dependent on –SH for their activity. Finally, the tripeptide glutathione is broadly discussed, and its intracellular function suggested to be the protection of the –SH groups of the protoplasmic proteins. "Pectic enzymes" by H. Linnweaver and E. F. Jansen is a good clarification of the properties of two enzymes catalyzing the hydrolysis of pectic substances—pectinesterase and polygalacturonase. Treatment of the subject is straightforward. The mode of pectinesterase activity is considered to be still unclear; that of polygalacturonase has been more definitely established. With respect to the latter, the main feature of its specificity is the failure to act in the proximity of methyl ester bonds. "Enzymic synthesis of polysaccharides" by E. J. Hehre is conceptually written, the particulars of treatment falling neatly into the one broad scheme of considering how biological synthesis of polymer-like substances occurs. Phosphorylase, levansucrase, amylosucrase and amylomaltase are discussed as instances of the general mechanism in polysaccharide synthesis—the transfer of one residue from a glycoside to a preexisting polysaccharide. Since the branching characteristic of the ultimate product is not mediated by these enzymes, reference is made to the recently discovered "Q" enzyme. "The biological transformations of starch" by Stanley Peat complements excellently the review of Hehre. This too is written with conceptual understanding, the scheme in this case basing itself exclusively on the one end-product, starch. The overlapping between the two treatments is welcome. The "Q" enzyme which appears to utilize the energy of the 1:4 glucosidic linkage by breaking it down and recombining the product in a 1:6 bond is fully and excellently discussed. "Chemical investigations on alliin, the specific principle of garlic" constitutes an extremely interesting chemical story. The presentation is enriched by a brief historical survey on the use of garlic since ancient days. The chemistry of the garlic principle, mainly unfolded by the authors themselves, is neatly and lucidly described. "Some problems of pathological wilting in plants" by E. Gaumann is largely a review of the toxigenic action of the peptide lycomarasmine. A number of its properties are described such as its disruption of the plasma-membrane, its tenfold increase in toxicity upon combining with the available iron in the plant, and the varying degrees of toxicity and pathenogenicity of different lycomarasmine producing fungal strains. The material is interestingly presented, but for a review it is somewhat encumbered with experimental details.

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