

which may produce either the seven-membered cyclic diamide or a polyamide. No molecular weight for the cyclic diamide was reported and attempts to obtain values on our compound have failed because of its insolubility.

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ON THE STRUCTURE OF BIOTIN

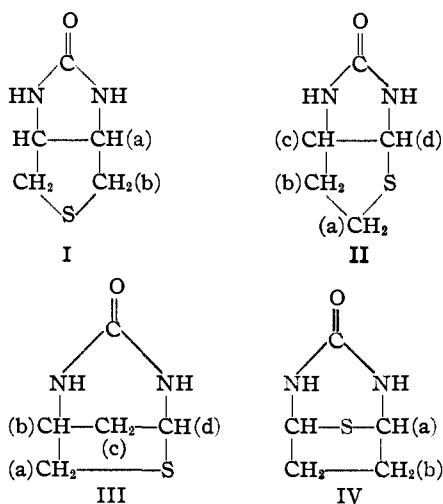
Sirs:

In a previous communication¹ we reported the isolation of adipic acid from the oxidation of the diaminocarboxylic acid derived from biotin; this finding greatly reduced the number of possible structures ascribable to biotin. Further restriction would result if it were possible to demonstrate that one of the carboxyl groups of the adipic acid was the original carboxyl group of biotin. We now wish to report evidence indicating this to be the case.

A Curtius degradation of biotin methyl ester was carried out. Biotin hydrazide (m. p. 238–240°), $C_{10}H_{18}O_2N_4S$ (calcd.: C, 46.50; H, 7.02; N, 21.69. Found: C, 46.82; H, 7.09; N, 21.88), through the azide yielded the corresponding ethyl urethan (m. p. 188–190°), $C_{12}H_{21}O_3N_3S$ (calcd.: C, 50.14; H, 7.37; N, 14.62. Found: C, 50.53; H, 7.64; N, 14.19). Hydrolysis of the urethan with barium hydroxide at 140° opened the urea ring and cleaved the urethan group to yield the triamine, $C_8H_{19}N_3S$, which was characterized as the tribenzoyl derivative (m. p. 194–195°), $C_{29}H_{31}O_3N_3S$, (calcd.: N, 8.37. Found: N, 8.01). The original carboxyl group was thus lost. Oxidation of the triamine under the conditions employed for the degradation of the diaminocarboxylic acid¹ was carried out and no adipic acid was isolated. The oxidation of the triamine was carried out on extremely small amounts of material. However, if adipic acid had been formed in yields comparable to that in the oxidation of the diaminocarboxylic acid we are confident that it should have been possible to isolate it.

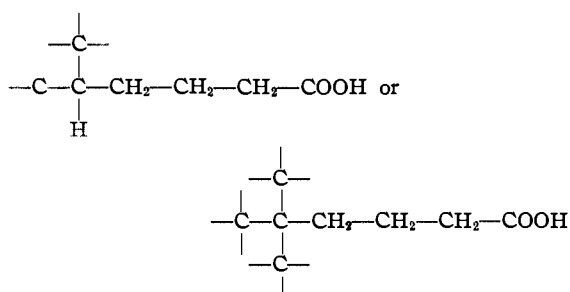
The most logical interpretation of these data is that biotin contains the side chain, $CH_2CH_2CH_2CH_2COOH$, attached to one of the ring carbons. On this basis, and eliminating consideration of 4-membered rings, we are led to the structures indicated below with the side chain replacing the

hydrogen atom at one of the positions indicated by a, b, c, or d.



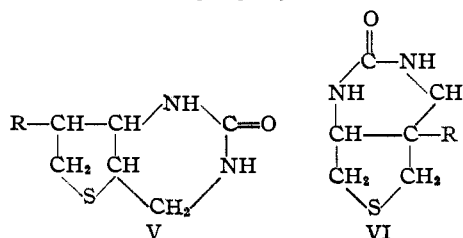
We feel that the remarkable stability of the diaminocarboxylic acid toward hydrolytic agents renders unlikely structures II, III, and IV, with both sulfur and nitrogen attached to a single carbon atom. Structure Ia or Ib would therefore seem most likely.

On the other hand, should the adipic acid arise from the decarboxylation of a malonic or an α -substituted β -keto acid arising during the oxidation, then biotin could contain the structural element

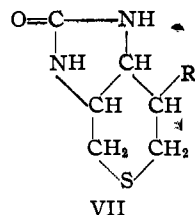


On this basis structures V, VI, and VII would therefore be possible (eliminating structures with sulfur and nitrogen on the same carbon atom for the reasons mentioned above).

$R = CH_2CH_2CH_2COOH$



(1) K. Hofmann, D. B. Melville and V. du Vigneaud, *THIS JOURNAL*, **68**, 3237 (1941).



Formulas Ib, V, VI and VII involve the assumption that the carbon atom attached to the sulfur

and proximal to the side chain can be oxidized to a carboxyl group. If this assumption be invalid, then only Ia remains. As material becomes available, the various questions raised in this Letter will be explored.

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NEW BOOKS

Practical Methods in Biochemistry. By FREDERICK C. KOCH, Frank P. Hixon Distinguished Service Professor of Biochemistry, University of Chicago. Third edition (revised). The Williams and Wilkins Company, Baltimore, Maryland, 1941. ix + 314 pp. 16 × 24 cm. 18 figs. Price, \$2.25.

In this edition, a number of typographical errors have been corrected, and new methods for the determination of uric, lactic and pyruvic acids have been added. Otherwise there are few changes from the second edition [reviewed in *THIS JOURNAL*, 60, 1270 (1938)]. The passages previously commented upon by the reviewer remain unchanged.

JOHN T. EDSALL

The Special Theory of Relativity. By HERBERT DINGLE, D.Sc., D.I.C., A.R.C.S., Professor of Natural Philosophy, Imperial College of Science and Technology. Chemical Publishing Co., Inc., 234 King Street, Brooklyn, N. Y., 1941. vi + 94 pp. 10 × 16.5 cm. Price, \$1.50.

Short as it is, this little book manages to contain good, bad, and indifferent material. Its general comments on the significance of the theory, contained in the first and last chapter and scattered in some other parts, are its best feature. The anti-metaphysical emphasis and the warnings against hypostatization of mathematical concepts should receive general approbation, though doubtless only occasional complete agreement—the tone is still a bit too subjective for the reviewer's taste, for example. The algebraic developments which fill most of the three chapters before the last are standard material, more or less indifferently well done. As for the *bad* part of the book, a glance at Chapters III and IV will reveal it to any physicist, and probably make him shudder to think of its ever being used as a text for "Honours Physics Students" or for anyone else. A beginning student may feel merely that the argument on pages 23 and 24, in which the Michelson-Morley experiment is "explained," is confusingly brief. To the reviewer—and most physicists would probably agree—it seems to show only the writer's immunity to any inkling

of the nature of a physical argument or proof. After this, one is only shocked rather than surprised to find, in Chapter IV, that the author apparently believes that t would not need to appear in the Lorentz transformation equations if only the mean solar second were defined in such a way as to escape a change in value of about one-millionth per cent. per century, due to tidal friction.

Professor Dingle's ability to talk well *about* theories is considerable, and most of us can get pleasure and a certain amount of profit from listening. When he tries to expound a theory *itself* in its essentials, the result is very different. What he has done for the general theory, which is discussed only in a general and interpretative way in the last chapter, seems quite good, as far as it goes. It is the spectacle of what happens to the special theory in this little book which keeps one from hoping he will go farther.

WENDELL H. FURRY

A Brief Course in Organic Chemistry. By REYNOLD C. FUSON, RALPH CONNOR, CHARLES C. PRICE AND H. R. SNYDER. John Wiley and Sons, Inc., New York, N. Y., 1941. x + 248 pp. 15 × 23 cm. Price, \$2.50.

This short but interesting text for students in agriculture, home economics, veterinary medicine, pre-dentistry and pre-medicine is noteworthy for its thoroughly up-to-date treatment of natural products and of the applications of organic chemistry. Emphasis is placed on the biochemical aspects of the subject. Benzene is introduced after the first few chapters on aliphatic hydrocarbons, and aromatic compounds are discussed along with aliphatic for each succeeding class. This permits laboratory work from the start with the more easily handled aromatic substances. The laboratory manual, comprising the last fifty pages, is well coordinated with the text. The book is well and concisely written, but especially the material in the early chapters will need explanation and expansion in order that students can acquire a sufficient familiarity with the fundamentals to appreciate the somewhat advanced chapters that follow.

THOMAS L. JACOBS