bered that a portion of the weight of the crystals is made up of the acetyl groups added. Maximum effect was obtained when 1 to 2 micrograms were added per cubic centimeter.

The mother liquor from the crystals (after hydrolysis) was approximately one fifth as active as the crystals. Recrystallization from alcohol-ether or from ethyl acetate-acetone or sublimation in high vacuum did not alter the activity detectably. A few milligrams of the crystals were hydrolyzed and the hydroxy acid was recombined with β-alanine, as previously described.[2] The product was highly active in promoting growth of *Lactobacillus casei*[7] (maximum effect wtih 0.1 micrograms per cc) as well as in causing growth response in rats fed a synthetic ration.[5,8]

While it is not impossible that the crystals are a mixture, the above facts make this possibility seem remote. It thus appears that both fragments of the pantothenic acid molecule have been obtained in a crystalline state.

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THE STRUCTURE OF PANTOTHENIC ACID

STUDIES on the structure of pantothenic acid were originated and carried forward in the laboratories of one of us[1,2,3,4,5] to the point where β-alanine[5] was recognized as one of its cleavage products and considerable information, in addition to that published, was obtained regarding the other portion of the molecule. A partial synthesis, using β-alanine ester, was also accomplished.[6]

Work on the chick anti-dermatitis factor was in progress in the Merck Research Laboratories when the announcement was made by Jukes[7] and Woolley, Waisman and Elvehjem[8] on the probable identity of the chick anti-dermatitis factor with pantothenic acid, and a cooperative arrangement was proposed to one of us (R.J.W.). By this arrangement all the techniques and experiences gained in the pantothenic acid studies were made available to the Merck Research Laboratories, where the crystalline lactone (cleavage product) was isolated and degraded, the exact structure of pantothenic acid determined, and its synthesis accomplished.

[7] Snell, E. E., F. M. Strong, W. H. Peterson, *Jour. Am. Chem. Soc.*, 60: 2825, 1938.

[8] G. H. Hitchings and Y. Subbarow, *Jour. Nutrition*, 18: 268, 1939.

[1] Williams, *et al.*, *Jour. Am. Chem. Soc.*, 55: 2912, 1933.

[2] R. J. Williams and Robin Moser, *Jour. Am. Chem. Soc.*, 56: 169, 1934.

[3] Williams, *et al.*, *Jour. Am. Chem. Soc.*, 60: 2719, 1938.

[4] *Ibid.*, 61: 454, 1939.

[5] Weinstock, *et al.*, *Jour. Am. Chem. Soc.*, 61: 1421, 1939.

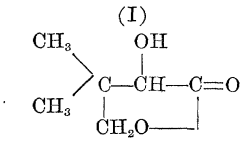
[6] R. J. Williams, SCIENCE, 89: 486, 1939.

[7] T. Jukes, *Jour. Am. Chem. Soc.*, 61: 975, 1939.

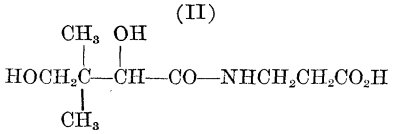
[8] Woolley, Waisman and Elvehjem, *Jour. Am. Chem. Soc.*, 61: 977, 1939.

The study was pursued in the Merck Research Laboratories with large amounts of liver concentrate. Purification methods were devised which gave concentrates containing 3 to 40 per cent. of barium pantothenate, from which the pure crystalline lactone (m.p. 91–92°) was obtained readily. Its composition corresponded to $C_6H_{10}O_3$, and its structure was shown by degradation to be that of α-hydroxy-β,β-dimethyl-γ-butyrolactone (I) which has been synthesized and condensed with β-alanine to produce physiologically active pantothenic acid (II).

(I)



(II)



This work in the Merck Research Laboratories was done by Drs. E. T. Stiller, J. C. Keresztesy and J. Finkelstein, and the results in detail will be published elsewhere under their authorship. An accompanying paper will present the unpublished data up to the point where the cooperation began.

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PRELIMINARY STUDIES ON MATING REACTIONS OF ENUCLEATE FRAGMENTS OF PARAMECIUM BURSARIA

RECENT studies by several investigators[1] have shown that there are distinct mating types in various species of Paramecium. Under appropriate conditions, individuals belonging to different mating types will agglutinate when they are mixed and later form pairs. Such agglutination has been called the "mating reaction." The purpose of the present investigation was to answer the question: Do enucleate fragments of Paramecium exhibit the mating reaction?

Paramecium bursaria—the green Paramecium—is especially favorable for the present study because of (1) the viability of fragments, (2) large size of the micronucleus, (3) permanence of mating type and (4) ease of cutting. Enucleate fragments of this species may remain alive for as long as four days. These fragments show a surprisingly normal behavior. In

[1] T. M. Sonneborn, *Proc. Nat. Acad. Sci.*, 23: 378–385, 1937; R. F. Kimball, *Proc. Nat. Acad. Sci.*, 23: 469–474, 1937; H. S. Jennings, *Proc. Nat. Acad. Sci.*, 24: 112–120, 1938; T. M. Sonneborn, *Proc. Amer. Phil. Soc.*, 79: 411–434, 1938; H. S. Jennings, *Genetics*, 24: 202–233, 1939.