12.20. Found:[3] C, 63.93, 64.07; H, 4.22, 4.30; S, 12.20, 12.17.

Oxidation of the sulfide with 30% hydrogen peroxide (Superoxol) in acetic acid–acetic anhydride gave *p*-chlorophenyl phenacyl sulfone, m. p. 133–134° (previously prepared by a different method, m. p. 132–133°).[4]

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[3] Microanalyses by Dr. Carl Tiedcke, New York, N. Y.

[4] Tröger and Beck, *J. prakt. Chem.*, [2] **87**, 296 (1913).

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING
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# COMMUNICATIONS TO THE EDITOR

## GROWTH INHIBITION OF LACTIC ACID BACTERIA BY N-(α,γ-DIHYDROXY-β,β-DIMETHYLVALERYL)-β-ALANINE AND ITS REVERSAL BY PANTOTHENIC ACID[1]

*Sir:*

It has been observed that pantothenic acid molecules with modified non-nitrogenous moieties exhibited diminished or inappreciable growth activity.[1a–3] Salicylol-β-alanine and mandelyl-β-alanine have been reported to be effective displacers of pantothenic acid.[4] A few analogs possessed inhibitory properties but their effects were not reversed by pantothenic acid.[3] In the present studies, the growth of lactic acid bacteria was inhibited markedly by N-(α,γ-dihydroxy-β,β-dimethylvaleryl)-β-alanine and the inhibition was reversed, competitively, by pantothenic acid over a wide range of concentrations.

α,α-Dimethyl-β-hydroxybutyraldehyde (b. p. 74–77° (15 mm.)), prepared as described by Lilienfeld and Tauss,[5] was converted to α-hydroxy-β,β-dimethyl-γ-valerolactone (b. p. 93–94.5° (1 mm.)) by the method of Stiller, *et al.*[6] The lactone crystallized from diethyl ether–petroleum ether as white hygroscopic needles. *Anal.* Calcd. for $C_7H_{12}O_3$: C, 58.31; H, 8.39. Found: C, 57.69; H, 8.47. The sodium salt of *dl* - N - (α,γ - dihydroxy - β,β - dimethylvaleryl)-β-alanine was prepared by fusing a mixture of the lactone and the sodium salt of β-alanine at 110–120°.

Acid production (ml. of 0.0385 *N* base to titrate final 3-ml. volumes) is shown in the Table I.

Mixtures of the lactone and β-alanine had little effect in concentrations as high as 10,000 γ per tube. It is of interest that stimulations occurred at low levels of the analog in the presence of pantothenic acid. Phenyl pantothenone has been reported to be stimulatory at sub-inhibitory levels.[7]

TABLE I

| Ca *d*-pantothenate per tube, γ | Analog[a] per tube, γ | *Lactobacillus arabinosus* 17–5, ml. | *Lactobacillus casei* ε, ml. | *Lactobacillus fermenti*, 36 ml. | *Leuconostoc mesenteroides* P–60, ml. |
|---|---|---|---|---|---|
| 0.0 | 0.0 | 4.05 | 1.80 | 1.55 | 2.33 |
| .02 | .0 | 9.95 | 4.78 | 2.10 | 4.50 |
| .06 | .0 | 13.90 | 10.45 | 3.70 | 6.90 |
| .20 | .0 | 14.85 | 14.18 | 6.00 | 9.00 |
| .60 | .0 | 14.90 | 15.57 | 8.30 | 10.65 |
| .02 | 2.0 | 9.82 | 4.15 | 2.50 | 5.00 |
| .02 | 6.0 | 9.45 | 2.05 | 2.55 | 5.15 |
| .02 | 10.0 | 9.05 | 1.73 | 2.35 | 5.00 |
| .02 | 20.0 | 8.05 | | 2.28 | 4.00 |
| .02 | 40 | 6.25 | | 1.55 | 2.75 |
| .02 | 80 | 4.05 | | | 2.30 |
| .20 | 60 | 15.40 | 4.70 | 6.30 | 9.07 |
| .20 | 100 | 14.75 | 2.15 | 5.70 | 8.35 |
| .20 | 200 | 12.35 | 1.78 | 4.05 | 7.65 |
| .20 | 400 | 8.90 | | 1.62 | 6.50 |
| .20 | 1000 | 4.05 | | | 2.30 |
| Antibacterial index[3] | | 4000–5000 | 500–1000 | 2000 | 4000–5000 |

[a] The analog was 83% condenseda ccording to Van Slyke amino nitrogen determination.

Preliminary experiments with streptococci indicated a high *in vitro* susceptibility to the inhibitor. Further studies on the activity and toxicity of this and other analogs are in progress.

The Dissertation (U. of Texas, 1943) of A. H. Nease has come to our attention. It was reported that N(α,γ-dihydroxy)-β,β-dimethylvaleryl)-β-alanine, prepared under the direction of Dr. H. R. Henze, had no growth activity for *L. casei.*

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[1] Aided by grants from the National Institute of Health of the U. S. Public Health Service and the U. of California.

[1a] Williams, *Adv. in Enzym.*, **3**, 253 (1943).

[2] Nease, Dissertation, U. of Texas (1943); quoted by Snell and Shive, *J. Biol. Chem.*, **158**, 551 (1945).

[3] McIlwain, *Biochem. J.*, **36**, 417 (1942).

[4] Martin, Lewis and Urist, Abstracts of Papers, 109th Meeting, *Am. Chem. Soc.*, 21B (1946).

[5] Lilienfeld and Tauss, *Monatsh.*, **19**, 77 (1898).

[6] Stiller, Harris, Finkelstein, Keresztesy and Folkers, THIS JOURNAL, **62**, 1785 (1940).

[7] Woolley and Collyer, *J. Biol. Chem.*, **159**, 263 (1945).

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## THE RAMAN SPECTRUM OF CYCLOÖCTATETRAENE

*Sir:*

A material obtained from Germany through the courtesy of the Office of Research and Inventions, U. S. Navy, and Division 16, NDRC, purporting to be 1,3,5,7-cycloöctatetraene, has been found to boil at 142° (uncor.) in agreement with the literature and to contain 92.2% C and 7.82% H in agreement with the calculated values 92.25% C and 7.75% H. The spectrum shows clearly that the material is not any substance, *e. g.*, styrene, for which Raman data are available and with which the material might be identified on the basis of its boiling point and elementary analysis.

As seen in Table I the number of Raman lines, and particularly of polarized lines, is small for any molecule of 16 atoms unless the molecule possesses considerable symmetry. The spectrum shows a strong carbon–carbon double bond frequency at a place which indicates that the double bond is not drastically affected by resonance, in contradistinction to the situation in benzene. The number of intense C–H stretching frequencies is small (three) and the spectral region over which they extend is narrow (*ca.* 60 cm.$^{-1}$). Only one C–H stretching frequency appears to be polarized.

TABLE I

RAMAN SPECTRUM OF CYCLOÖCTATETRAENE

| Frequency in cm.$^{-1}$ | Intensity | Approximate depolarization | Frequency in cm.$^{-1}$ | Intensity | Approximate depolarization |
|---|---|---|---|---|---|
| 194 | 9 | 1/2 | 1410 | 0 | . . . |
| 249 | 4 | 6/7 | 1439 | 6 | 6/7 |
| 292 | 3 | 6/7 | 1461 | 0 | . . . |
| 366 | 7 | 6/7 | 1570 | 0 | . . . |
| 497 | 0 | . . | 1601 | 3 | 6/7 ? |
| 655 | 2 | . . | 1631 | 5 | 6/7 ? |
| 728 | 00 | . . | 1650 | 10 | 1/5 |
| 758 | 0 | . . | 1743 | 1 | . . . |
| 873 | 8 | 1/10 | 2793 | 1 | . . . |
| 905 | 0 | . . | 2832 | 1 | . . . |
| 948 | 5 | 6/7 | 2853 | 1 | . . . |
| 964 | 1 | . . | 2954 | 10 | 6/7 |
| 1202 | 7 | 6/7 | 3003 | 10 | 6/7 |
| 1221 | 2 | . . | 3013 | 10 | <6/7 |
| 1282 | 0 | . . | 3048 | 1 | . . . |

The following conclusions may reasonably be drawn from the Raman data alone: (1) The molecule cannot have cubic symmetry ($O_h$) or planar symmetry with an eight-fold axis ($D_{8h}$) because the number of polarized lines observed is too large. The location of the polarized C=C frequency at 1650 cm.$^{-1}$ is consonant with this conclusion. (2) The molecule cannot have two different geometrical forms (space isomers analogous to "chair" and "boat" forms of cyclohexane) in equilibrium because the spectrum is too simple. (3) All the hydrogen atoms are equivalent. (4) The molecule contains no –C≡C–, $-CH_2-$ or $-CH_3$ groups nor a benzene ring with side groups or rings. (5) The molecule possesses a multiple axis of symmetry.

Detailed consideration of the Raman spectrum leads us to believe that it can best be interpreted on the basis of a $D_4$ structure (puckered 8-membered ring with alternate single and double bonds). This conclusion is of course less certain than the five listed above. At present we are studying the infrared spectrum of the vapor, making further measurements on the depolarization factors of the Raman lines and attempting the preparation of the isotopic molecule $C_8D_8$. A thorough interpretation of the Raman spectrum will be deferred until these additional spectroscopic studies have been carried out.

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# NEW BOOKS

**Catalytic Chemistry.** By HENRY WILLIAM LOHSE, Ph.D., F.C.I.C., Consulting Chemist. Chemical Publishing Co., Inc., Brooklyn, New York, 1945. xiv + 471 pp. 30 illustrations. 14.5 × 22.5 cm. Price, $8.50.

The author has aimed "to present a text which, when carefully studied, will permit a chemist with elementary training to obtain a concrete idea what catalytic chemistry deals with andw hat its working principles are." "Numerous references have been made to original treatises on specialized subjects and it is hoped it will be helpful to those who want to study any specific subject. Considerable stress has been laid on the subject of minor constituents (impurities) but, unfortunately, there are very few published data which can be included at this time." The four leading chapters of the book are entitled, Catalytic Theory (106 pp.); Nature and Properties of Catalysts (69 pp.); Specific Types of Catalytic Reactions (120 pp.) and Industrial Catalytic Reactions (120 pp.). In a foreword Dr. E. Emmet Reid states that "Sabatier covered the field of organic catalysis; no mortal can do that now." "Dr. Lohse has brought together many facts, but his chief concern has been the significance of their relations. May this book catalyze further progress in catalysis." The reviewer is of the opinion that Dr. Lohse's book is a worthwhile addition to any library of chemistry since the statement by Dr. Reid quoted just above, is well justified.

HOMER ADKINS

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**On the Structure of the Protein Molecule.** By N. TROENSEGAARD. Einer Munksgaard, Norregarde 6, Copenhagen, Denmark (Humphrey Milford, Oxford University Press, London), 1944. 126 pp. 16 × 24 cm. Price, Dan. Cr. 14,000.

This book summarizes the researches of Troensegaard in protein chemistry during the last twenty-five years. Some of the material has been previously published in