The quantitative periodate oxidation experiments on III and IV indicate the presence of a single 1,2-glycol grouping in III and the appearance of a second one in IV as a result of the removal of desosamine. This evidence shows that desosamine is linked to one or the other of the carbon atoms involved in this second group.

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ERYTHROMYCIN. V. ISOLATION AND STRUCTURE OF DEGRADATION PRODUCTS

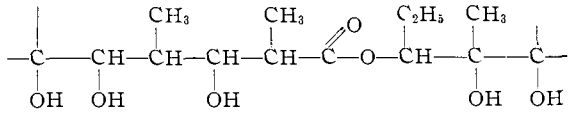
Sir:

Periodate oxidation of dihydroerythronolide (I)[1] followed by alkaline hydrolysis and oxidation gave an acid (II). This acid was identified as α,α'-dimethyl-β-hydroxyglutaric acid by conversion to its bis-(*p*-bromophenacyl) ester, m.p. 138–141° [Calcd. for $C_{23}H_{22}O_7Br_2$: C, 48.44; H, 3.89; Br, 28.03; mol. wt., 570. Found: C, 48.68; H, 4.09; Br, 27.46; mol. wt., 590] identical with the derivative of an authentic sample[2] as shown by the usual physical tests.

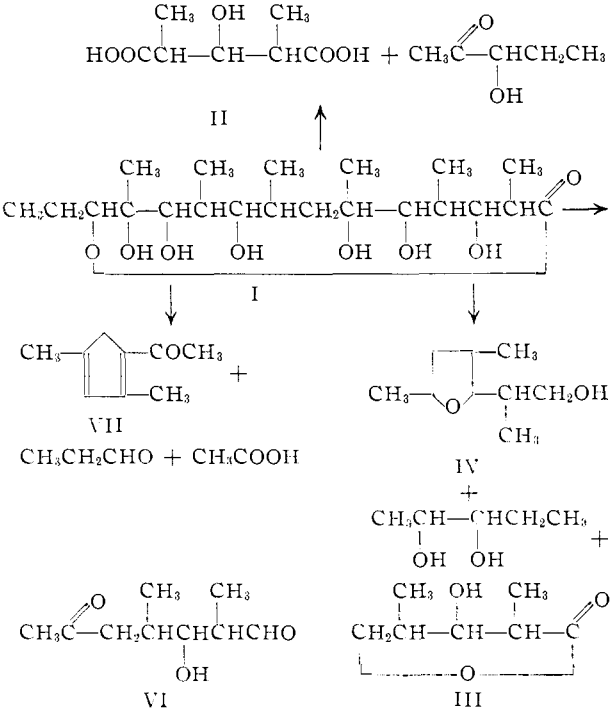
Degradation of I by periodate oxidation followed by catalytic reduction and alkaline hydrolysis formed three products. One of these was a sodium salt which on acidification gave a lactone (III), m.p. 88–88.5° [Calcd. for $C_7H_{12}O_3$: C, 58.33; H, 8.33; C-CH_3 (2), 20.9; mol. wt., 144. Found: C, 58.27; H, 8.27; C-CH_3, 19.9; mol. wt., 144 (saponification equivalent); $[\alpha]^{27}D$ −5° (*C*, 2 in methanol)]. There was infrared absorption in the 2.9 μ region indicative of hydroxyl and a lactone band at 5.82 μ. The second product was a neutral liquid (IV), b.p. 87–88° at 5 mm. [Calcd. for $C_9H_{18}O_2$: C, 68.31; H, 11.47; C-CH_3 (3), 28.5; mol. wt., 158. Found: C, 68.15; H, 11.39; C-CH_3, 23.8; mol. wt., 176; $n^{20}D$ 1.4519; $[\alpha]^{26}D$ +15° (*C*, 1 in methanol)]. Infrared absorption at 2.85 μ indicated hydroxyl. This compound gave a negative iodoform reaction and did not decolorize bromine in carbon tetrachloride. 2,3-Pentanediol (V),[3] b.p. 38° at 0.05 mm. [Calcd. for $C_5H_{12}O_2$: C, 57.69; H, 11.54. Found: C, 57.74; H, 11.78; $n^{25}D$ 1.4402; $[\alpha]^{28}D$ +20° (*C*, 1 in water)] also was isolated and identified by consumption of one mole of periodate per mole and oxidation with bromine to 2,3-pentanedione whose bis-(2,4-dinitrophenylhydrazone) was identical with an authentic sample as shown by the usual physical tests.

Base hydrolysis of dihydroerythronolide followed by periodate oxidation formed propionaldehyde, acetic acid, a neutral product (VI) and another acid presumably an aldehyde acid. Compound VI gave a positive iodoform reaction and formed an incompletely purified bis-(2,4-dinitrophenylhydrazone), m.p. 235–237° [Calcd. for $C_{21}H_{24}N_8O_9$: N, 21.12. Found: N, 21.19]. Treatment of VI with dilute sodium hydroxide gave a product (VII) which formed a 2,4-dinitrophenylhydrazone, m.p. 205–206° dec. [Calcd. for $C_{15}H_{16}N_4O_4$: C, 56.96; H, 5.08; N, 17.71, mol. wt., 316. Found: C, 56.78; H, 5.16; N, 17.48, mol. wt., 321]. The ultraviolet spectrum had a maximum at 402 mμ, ϵ 75,800 consistent with an α,β-γ,δ-unsaturated carbonyl 2,4-dinitrophenylhydrazone.

The first seven carbon atoms of I must be represented by the two seven-carbon compounds isolated since these are the only ones containing the —C(=O)—O— grouping of I. The presence of a second carboxyl in II and the hydroxylactone nature of III are consistent with periodate oxidation of I to an aldehyde-acid followed by oxidation to II or reduction to III. This also establishes the structure of III. In conjunction with the previous evidence[1] regarding the ester or lactone grouping in I, the following partial structure can be written for I.



The remaining nine carbon fragment of I is represented by IV and VII. These must be derived from a common precursor (VI) which would be expected to have two carbonyl and one hydroxyl oxygen atoms. The bis-(2,4-dinitrophenylhydrazone) of VI establishes the presence of two carbonyl groups. The positive iodoform reaction on VI indicates an acetyl or potential acetyl group. The molecular formula for VII is that expected if in VI there is β-hydroxycarbonyl and 1,4-, 1,5- or 1,6-dicarbonyl. The molecular formula for IV coupled with its saturation indicates a tetrahydrofuran or tetrahydropyran. The negative iodoform



(1) P. F. Wiley, K. Gerzon, E. H. Flynn, M. V. Sigal, Jr., and U. C. Quarck, THIS JOURNAL, **77**, 3676 (1955).

(2) S. Reformatski, *Ber.*, **28**, 3263 (1895).

(3) The synthesis of *dl*-erythro-2,3-pentanediol has been reported: see H. J. Lucas, M. J. Schlatter and R. C. Jones, THIS JOURNAL, **63**, 22 (1941).

reaction of IV indicates the participation of the iodoform reactive group of VI in the cyclization. There are three C–CH_3 groups present. These data make structure IV likely for this compound and VII most probable for the product of base treatment of VI.

The above partial structure contains recurring head to tail units and such a unit seems probable

in VI due to the three C–CH_3 groups present. The very logical assumption can be made that VI would fit into I to give a recurring propionate unit throughout and giving structure I for dihydroerythronolide. From previous information regarding the position of desosamine it can now be placed at C-5 or C-6 in I.

The definite placement in erythromycin of desosamine, cladinose and the ketonic carbonyl function at three of the few possible positions (C-3, C-5, C-6 and C-9) of I remains. Evidence concerning these points will be forthcoming.

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BOOK REVIEWS

Organic Syntheses. Collective Volume 3. A revised Edition of Annual Volumes 20–29. By E. C. HORNING, Editor-in-Chief. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1955. x + 890 pp. 16 × 23.5 cm. Price, $15.00.

The material contained in the annual Volumes of Organic Syntheses 20 through 29 is here collected, edited and revised to date. Seven new and improved procedures have been added. To bring the section on Methods of Preparation up to date the literature has been surveyed through Volume 46 (1952) of *Chemical Abstracts*. A useful aid is the new index section on the purification of solvents and reagents. In other details this volume adheres closely to previous volumes. This outstanding series is so well known and so important for all practicing organic chemists that it requires no further introduction.

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Modern Aspects of Electrochemistry. Edited by J. O'M. BOCKRIS, D.Sc., Ph.D., D.I.C., F.R.I.C. with the assistance of B. E. CONWAY, Ph.D., D.I.C., A.R.I.C. Academic Press, Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1954. x + 344 pp. 15 × 22 cm. Price, $6.80.

This book is composed of five chapters of approximately sixty pages each which survey the recent developments of the following subjects: (1) Physical Chemistry of Synthetic Polyelectrolytes by H. Eisenberg and R. M. Fuoss, (2) Ionic Solvation by B. E. Conway and J. O'M. Bockris, (3) Equilibrium Properties of Electrified Interfaces by R. Parsons, (4) Electrode Kinetics by J. O'M. Bockris, (5) Electrochemical Properties of Nerves and Muscles by W. F. Floyd.

The physical chemistry of polyelectrolytes is presented in a brief and authoritative manner. The illusive problem of ionic solvation is discussed from the point of view of hydration numbers and the structure breaking effects of the ions. The next chapter contains survey of the theories of solid–liquid interfaces and the fourth chapter develops a kinetic theory of electrodes based on the analogy of Tafel's equation for overvoltage and Eyring's activation theory of reaction velocity. Much of this theory as is to be expected has only a tenuous relation to experiment. The final chapter contains a lucid description of recent researches of transport and potentials across membranes.

This book containing articles which cover wider areas than reviews and smaller areas than monographs should serve the purpose of acquainting interested persons rapidly with some of the modern aspects of the subjects discussed. The extensive bibliographies of over nine hundred references are a valuable part of this book.

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The Vitamins. Chemistry, Physiology, Pathology. Volume II. Edited by W. H. SEBRELL, JR., Director, National Institutes of Health, Bethesda, Maryland, and ROBERT S. HARRIS, Professor of Biochemistry of Nutrition, Massachusetts Institute of Technology, Cambridge, Massachusetts. Academic Press, Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1954. xiii + 766 pp. 16.5 × 23.5 cm. Price, $16.50.

To own this volume (the second of three) and to be able to refer to it for information concerning the chemistry, physiology and pathology of vitamins D and K, niacin, pantothenic acid, choline, inositol and the essential fatty acids will be most rewarding. It is authoritative, up-to-date, and well indexed. However, to review a book of this type is frustrating. Each section, covering one of the seven vitamins, deserves a review since it is a book in itself. Furthermore, each section was written by at least three groups of contributors (a total of 29 individuals contributed to the book) with different style and with some overlapping of coverage. However, this overlapping is not objectionable since it brings out differences in viewpoint, *e.g.*, the treatment of lipotropic activity in both the inositol and the choline chapters.

The chemistry (synthesis and analysis) and the pathology (tissue changes resulting from vitamin deprivation or overdosage) of these seven vitamins are well established. The vitamins will remain a stable reference book in this respect for a long time. However, the physiology (the mechanism whereby these essential dietary compounds perform their vitamin function in the body) is incompletely understood. Uncertainties about physiological action may be cited for each of these vitamins: ". . . the essentiality of [pantothenic acid] in coenzyme A still presents a challenge to our biochemical imagination." ". . . little is known of its [vitamin D] action. . . . Newer methods are needed for these studies." "Clarification of the role of [choline] . . . must await the recognition and isolation of the numerous enzymes and cofactors concerned with the fascinating mechanisms of methyl synthesis and methyl transfer." "Although the pathways of [inositol] metabolism in bacteria are better understood than those in animal tissues, knowledge in this field is still in a relatively primitive