ley of the Department of Zoology, have indicated androgenic activity for the diketone II at a total dose of 2.5 mg. (26 to 83% increase in comb weight over the controls). A total dose of 0.012 mg. of testosterone propionate resulted in 40% increase. The keto alcohol I has given inconclusive results. Further investigation of physiological effects in other species awaits the preparation of additional material.

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SYNTHESIS OF VITAMIN A

Sir:

The appearance of an article by Schwarzkopf and collaborators[1] on the synthesis of vitamin A by the reduction of vitamin A esters with lithium aluminum hydride prompts us to record experimental work carried out in these laboratories.

Ethyl β-ionylidene acetate[2] was reduced with lithium aluminum hydride in 85% yield to β-ionylidene ethyl alcohol following the method of Milas and Harrington[3] [b. p. 112–114° at 0.4 mm.; $\lambda_{\text{max.}}^{\text{isoöctane}}$ 2840 Å., $E_{1\,\text{cm.}}^{1\%}$ 1205]; *trityl ether* (m. p. 132–134°) *anal.* Found: C, 88.13; H, 8.47; $\lambda_{\text{max.}}^{\text{isoöctane}}$ 2850 Å., $E_{1\,\text{cm.}}^{1\%}$ 733.

Oxidation of β-ionylidene ethyl alcohol with manganese dioxide by the method used to convert vitamin A to the aldehyde[4] produced a mixture of two stereoisomeric β-ionylideneacetaldehydes in 60% yield separable by chromatography into essentially equal amounts of *nor*-β-ionylideneacetaldehyde[5] [b. p. 90–95° at 10^{-2} mm.; $n^{25}\text{D}$ 1.5780; $\lambda_{\text{max.}}^{\text{isoöctane}}$ 2650 Å., $E_{1\,\text{cm.}}^{1\%}$ 567 and 3150 Å., $E^{1\%}$ 760, *anal.* Calcd. for $C_{15}H_{22}O$: C, 82.57; H 10.09. Found: C, 82.14; H, 10.36. *Semicarbazone:* m. p. 195–196°; $\lambda_{\text{max.}}^{\text{chloroform}}$ 3230 Å., $E_{1\,\text{cm.}}^{1\%}$ 1330; *anal.* Found: C, 69.56; H, 8.82; N, 15.29][6] and *iso*-β-ionylidene acetaldehyde[5] [b. p. 80–85° at 10^{-2} mm.; $n^{25}\text{D}$ 1.5780; $\lambda_{\text{max.}}^{\text{isoöctane}}$ 3180 Å., $E_{1\,\text{cm.}}^{1\%}$ 904. *Anal.* Found: C, 82.14; H, 10.33. *Semicarbazone:* m. p. 175–176°, $\lambda_{\text{max. }3175}^{\text{chloroform}}$ $E_{1\,\text{cm.}}^{1\%}$ 1000. *Anal.* Found: C, 70.16; H, 9.07; N, 15.03].

nor-β-Ionylideneacetaldehyde was condensed with acetone in the presence of aluminum *t*-butoxide whereby the previously described C_{18}-ketone was obtained[7] in 80–85% yield; $\lambda_{\text{max.}}^{\text{isoöctane}}$ 3360 Å.; *semicarbazone:* m. p. 186–188°; $\lambda_{\text{max.}}^{\text{chloroform}}$ 3490 Å., $E_{1\,\text{cm.}}^{1\%}$ 1680. The C_{18}-ketone was converted by the Reformatsky reaction to the C_{20}-hydroxyester which was dehydrated by iodine to vitamin A ester and the latter saponified to vitamin A acid, m. p. 179–180°; $\lambda_{\text{max.}}^{\text{ethanol}}$ 3500 Å., $E_{1\,\text{cm.}}^{1\%}$ 1415. From *iso*-β-ionylideneacetaldehyde there was obtained a more difficultly characterizable C_{18}-ketone exhibiting a broad band at 3340–3370 Å. indicating a mixture of the *nor* and *iso* forms. This ketone afforded vitamin A acid in the same yield as that obtained from the *nor* series (25%); m. p. 180.5–181.5°; $\lambda_{\text{max.}}^{\text{ethanol}}$ 3530 Å., $E_{1\,\text{cm.}}^{1\%}$ 1510; mixed m. p. with acid from *nor* series, 180–181°. Both vitamin A acids on reduction with lithium aluminum hydride gave vitamin A exhibiting a single, well-defined maximum at 3260 Å., $E_{1\,\text{cm.}}^{1\%}$ 1330 (80% yield) as measured in isoöctane.

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(1) Schwartzkopf, Cahnmann, Lewis, Swindinsky and Wuest, *Helv. Chim. Acta*, **32**, 443 (1949).

(2) Karrer, Salomon, Morf and Walker, *ibid.*, **15**, 878 (1932).

(3) Milas and Harrington, THIS JOURNAL, **69**, 2247 (1947).

(4) Ball, Goodwin and Morton, *Biochem. J.*, **42**, 516 (1948).

(5) The names *nor*- and *iso*-β-ionylideneacetaldehyde denote stereochemical relationships to β-carotene. The *nor* (normal) aldehyde is obtainable from β-carotene by oxidation—Wendler, Rosenblum and Tishler, THIS JOURNAL, in press.

(6) The β-ionylidenealdehydes semicarbazones prepared by Kuhn and Morris, *Ber.*, **70**, 853 (1937), and by van Dorp and Arens, *Rec. trav. chim.*, **67**, 459 (1948), apparently have the *nor* configuration.

(7) Arens and van Dorp, *Rec. trav. chim.*, **65**, 338 (1946); Heilbron, Jones and O'Sullivan, *J. Chem. Soc.*, 866 (1946); Karrer, Jucker and Schick, *Helv. Chim. Acta*, **29**, 704 (1946).

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NEW BOOKS

Oxidation–Reduction Potentials in Bacteriology and Biochemistry. By L. F. HEWITT, Ph.D., B.Sc., F.R.I.C., Acting Director, Serum Research Institute, Carshalton, Surrey. Fifth Edition. Published by the London County Council, 1948, and may be purchased, either directly or through any Bookseller, from Staples, Ltd., 14, Great Smith Street, Victoria Street, Westminster, S.W.1. 130 pp. 17 × 25 cm. Price, 4s. 6d. By post, 4s. 10d.

The last previous edition of this small monograph was published in 1936. The present fifth edition follows the pattern of earlier ones. The first chapter contains a brief outline of the theory of oxidation–reduction reactions and the mathematical expressions relating oxidation–reduction potentials to the components of the reactions. The second chapter describes the methods for measuring oxidation–reduction potentials and gives tables of oxidation–reduction indicators. The third chapter deals with oxidation–reduction systems of biological interest. In the fourth chapter, the bacteriological applications of oxidation–reduction studies are described. This fourth chapter is the most important in the monograph, since it constitutes the best review of the work in this particular field—a field to which the author himself has made many contributions. The monograph concludes with two short