# THE REDUCTION OF $\alpha$ -KETOL ESTERS

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In the course of work on adrenaline, the authors had occasion to note the claim by Voswinckel<sup>1</sup> that  $\alpha$ , 3, 4-triacetoxyacetophenone could be reduced to  $\alpha$ , 3, 4-triacetoxyethylbenzene by means of zinc dust and acetic acid. The general course of the reduction of ketones of the type —COCH<sub>2</sub>X, where X is a negative group, by reagents of the type quoted appears to be, from examination of the literature, to the group —COCH<sub>3</sub> or —CH<sub>2</sub>CH<sub>3</sub> and not to the group —CH<sub>2</sub>CH<sub>2</sub>X<sup>2-12</sup>. If the work of Voswinckel could be established we would be in possession not only of a compound required in our research, but also of a method of conversion of the halogenated compounds —COCH<sub>2</sub>X to the alcohols —CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH and thus a synthesis of such substances as the valuable  $\beta$ -phenethyl alcohols and amines from the easily accessible phenacyl halides.

No account was found in the literature of any repetition of the reduction of  $\alpha$ , 3, 4-triacetoxyacetophenone and accordingly it was attempted in these laboratories. We were unable to isolate the compound claimed by Voswinckel. The major product of the reaction appears to be not  $\alpha$ , 3, 4-triacetoxyethylbenzene but 3, 4-diacetoxyacetophenone. Analogously the reduction of  $\alpha$ -acetoxyacetophenone under approximately the same conditions led to acetophenone and not phenethyl alcohol.

Voswinckel reported a decomposition of the so-called  $\alpha,3,4$ -triacetoxyethylbenzene at 130° into acetaldehyde and 3,4-diacetoxyphenylacetaldehyde. The latter was described as melting one degree lower than the isomeric 3,4-diacetoxyacetophenone isolated by us.

- <sup>1</sup> VOSWINCKEL, Ber., 42, 4651 (1909).
- <sup>2</sup> LINNEMAN, Ann., 134, 171, (1865).
- <sup>3</sup> Kling, Bull. soc. chim., [3], 35, 211, 215 (1906).
- <sup>4</sup> FAVORSKII, J. prakt. Chem., [2], 51, 536 (1895).
- <sup>5</sup> KLING, Ann. Chim. [8], 5, 506 (1905).
- <sup>6</sup> FITTIG AND ERLENBACH, Ann., 269, 27 (1892).
- <sup>7</sup> GARDEUR, Chem. Zentr., 1897, II, 661.
- <sup>8</sup> IRVINE AND WEIR, J. Chem. Soc., 91, 1388 (1907).
- <sup>9</sup> DZIERGOWSKI, Ber., 26, Ref. 589 (1893).
- <sup>10</sup> v. Auwers and Pohl, Ann., 405, 264 (1914).
- <sup>11</sup> JOHNSON AND HODGE, J. Am. Chem. Soc., 35, 1023 (1913).
- <sup>12</sup> HORII, J. Pharm. Soc. Japan, 53, 1239 (1933).

#### EXPERIMENTAL

Chloracetyl catechol was prepared by the method of Dziergowski<sup>9</sup>.

 $\alpha$ , 3, 4-Triacetoxyacetophenone.—This compound was prepared according to Voswinckel's directions; m.p. 95°.

Anal. Calc'd for C14H14O7: C, 57.14; H, 4.76.

Found: C, 57.22; H, 4.79.

Reduction of  $\alpha$ , 3, 4-triacetoxyacetophenone.—The procedure of Voswinckel was followed and the temperature kept at 90°. After the first solidification of the product it was recrystallized three times from water; m.p., 84-85°; yield, 8 g. Voswinckel reported m.p., 85°.

Anal. Calc'd for  $C_{14}H_{16}O_{6}$ ,  $\alpha$ , 3, 4-triacetoxyethylbenzene: C, 59.98; H, 5.67. Calc'd for  $C_{12}H_{12}O_{5}$ , 3, 4-diacetoxyacetophenone: C, 61.01; H, 5.12. Found: C, 61.20; H, 5.47.

This analysis suggested 3,4-diacetoxyacetophenone. The preparation was repeated at 40°, and anhydrous solvents were used for purification. Two recrystallizations from absolute alcohol gave white crystals, m.p. 87°.

Anal. Calc'd for C<sub>12</sub>H<sub>12</sub>O<sub>5</sub>: C, 61.01; H, 5.12.

Found: C, 60.90; H, 5.22.

Semicarbazone of the reduction product.—A semicarbazone was formed in the usual manner from the reduction product of  $\alpha$ ,3,4-triacetoxyacetophenone. The white, crystalline semicarbazone was insoluble in cold water or alcohol. It was recrystallized from alcohol, m.p. 212-213°.

Anal. Calc'd for C<sub>14</sub>H<sub>12</sub>N<sub>3</sub>O<sub>5</sub>: C, 53.22; H, 5.16; N, 14.32.

Found: C, 53.00; H, 5.25; N, 14.23.

Hydrolysis of the reduction product.—The reduction product was treated with a concentrated solution of sodium carbonate. The reaction was completed by warming for several minutes until the solution became yellow. After acidification it was extracted with ether, and the ether was evaporated. The amorphous residue was vacuum-sublimed and recrystallized from xylene; m.p. 114–115°. The same compound was obtained by refluxing with five per cent. sulfuric acid for fifteen minutes.

Anal. Calc'd for C<sub>8</sub>H<sub>8</sub>O<sub>8</sub>: C, 63.16; H, 5.30.

Found: C, 63.46; H, 5.52.

Acetocatechol was prepared by the method of Stephen and Weizman<sup>13</sup>, by reduction of chloracetocatechol. The product was purified by vacuum sublimation as by Mosettig and Burger<sup>14</sup>. This was melted with the hydrolysis product of the preceding experiment; mixture m.p., 117°.

3,4-diacetoxyacetophenone.—Acetocatechol was acetylated by adding acetic anhydride to an iced solution of its potassium salt. The diacetate was recrystallized from alcohol; m.p. 86°. This was melted with the second reduction product of  $\alpha,3,4$ -triacetoxyacetophenone; mixture m.p., 86°.

3,4,-Diacetoxyacetophenone semicarbazone.—This semicarbazone was prepared in the usual manner from the product of the preceding experiment. It was recrystallized from alcohol; m.p., 212°.

Anal. Calc'd for  $C_{14}H_{12}N_{3}O_{5}$ : C, 53.22; H, 5.16.

Found: C, 52.23; H, 5.15.\*

<sup>14</sup> MOSETTIG AND BURGER, J. Am. Chem. Soc., 52, 2988 (1930).

<sup>&</sup>lt;sup>13</sup> STEPHEN AND WEIZMAN, J. Chem. Soc., 105, 1051 (1914).

<sup>\*</sup> We wish to thank Mr. Saul Gottlieb for the microanalyses.

This was melted with the semicarbazone of the reduction product of  $\alpha$ , 3, 4-triace-toxyacetophenone: mixture m.p., 213°.

Reduction of  $\alpha$ -acetoxyacetophenone.—Six grams of  $\alpha$ -acetoxyacetophenone was dissolved in 100 cc. of glacial acetic acid; 10 g. of zinc dust was added in the course of four hours to the mechanically stirred mixture at 40°. The mixture was then filtered, and the diluted filtrate was extracted with ether; yield 80% of the theoretical.

Acetophenone semicarbazone.—One gram of the product from the preceding experiment was converted in 95% yield to acetophenone semicarbazone; m.p. 201°.

## SUMMARY

The reported preparation by Voswinckel of  $\alpha$ ,3,4-triacetoxyethylbenzene from  $\alpha$ ,3,4-triacetoxyacetophenone could not be duplicated. The so-called 3,4-diacetoxyphenylacetaldehyde was not obtained, but only the isomeric 3,4-diacetoxyacetophenone. The reduction of  $\alpha$ acetoxyacetophenone similarly yields acetophenone, and not  $\beta$ -phenethyl alcohol or an ester thereof.