

nucleus. However, benzalacetophenone and benzalacetone, the vinyllogs of benzophenone and acetophenone, respectively, were not affected.

4. In a further set of experiments the influence of aromatic substitution on the pinacolization of acetophenone was studied with the view of synthesizing the pinacol III, which could serve as a suitable starting material for stilboestrol.³ *p*-Methoxypropiophenone did not react at all, and the *p*-acetoxy-, propoxy- and butyroxycetophenone only suffered partial deacylation to *p*-hydroxypropiophenone; the acetoxy compound yielded also traces of pinacol III ($R = \text{CH}_3\text{CO}-$).

Finally, it was found that under our experimental conditions benzoin undergoes a reverse Cannizzaro reaction, giving benzaldehyde as the only reaction product.

Experimental Part

Under the conditions used, benzophenone in 6.7% solution gave 100% of pinacol after fifteen hours of irradiation, acetophenone 70%.

(1) α -Indanone.—The ketone (20 g.) in isopropanol (150 cc.) was irradiated for ten hours and the mixture fractionated. The residue was triturated with toluene. From isopropanol it gave prisms of II, m. p. 142–143°.

Anal. Calcd. for $\text{C}_{18}\text{H}_{14}\text{O}$: C, 87.8; H, 5.7. Found: C, 87.0; H, 5.7.

When the same reaction was carried out in sunlight (30 days), a small amount of another product was obtained, which crystallized from nitrobenzene or pyridine in beautiful brown rods, m. p. 352–353°. With concd. sulfuric acid a violet color appears which turns slowly to red-brown; no reaction with bromine. No method was found for determining the molecular weight.⁴

Anal. Calcd. for $\text{C}_{28}\text{H}_{20}\text{O} (2 \times \text{C}_{18}\text{H}_{14}\text{O} - \text{H}_2\text{O})$: C, 91.1; H, 5.5. Found: C, 92.8, 93.1; H, 5.65, 5.5.

(2) α -Tetralone.—After evaporation of the solvent, the pinacol crystallized only partially, most of it was obtained in solid form only after distillation, b. p. 220° (4 mm.); from butyl acetate as beautiful prisms, m. p. 192°.⁵ Ten grams of tetralone yielded 7.5 to 8 g. of pinacol. For

(3) Dodds, Golberg, Lawson and Robinson, *Proc. Roy. Soc. (London)*, **B127**, 140 (1939).

(4) It is very probable, that this substance is impure bouxene, $\text{C}_{27}\text{H}_{18}$, the m. p. of which is given as 369–370° by Stobbe, *Ber.*, **60**, 457 (1927). We thank Dr. Ernst Bergmann for this suggestion.

(5) Barnett and Lawrence, *J. Chem. Soc.*, 1104 (1935).

identification the product was converted into the diene by dehydration in acetic acid–acetic anhydride mixture. From high-boiling petroleum ether the diene gave prismatic blocks, m. p. 141–142°.

Pinacolization of the tetralone was favored by dilution, mainly because the formation of a brown film around the quartz lamp was thereby avoided. Thus, using 50 g. of tetralone in 100 cc. of either isopropanol or isopropanol and benzene, there was obtained a 3% yield of pinacol in ten hours; using 20 g. and 5 g. in 150 cc. of isopropanol, there were obtained in ten and twenty hours, 10 and 80% yields of pinacol, respectively. Ten grams of tetralone in 10 cc. of isopropanol after thirty days in sunlight gave a 40% yield of pinacol.

(3) Desoxybenzoin.—The residue from the distillation of unreacted ketone was recrystallized from butanol, m. p. 214°, and identified with an authentic sample of the pinacol.

(4) 1,4-Diphenylbutanone-1.—This ketone was prepared by a Grignard reaction between benzonitrile (18 g.) and γ -phenylpropylmagnesium bromide (one-sixth mole). On working up the mixture with dilute sulfuric acid, the ketimine was hydrolyzed in the cold and the ketone obtained directly, b. p. 180° (6 mm.),⁶ 155° (0.2 mm.), yield 50%. The irradiation yielded a small amount of a high-boiling sirup, b. p. 190° (0.25 mm.), which could not be induced to crystallize.

Anal. Calcd. for $\text{C}_{32}\text{H}_{24}\text{O}_2$: C, 85.3; H, 7.6; mol. wt., 450. Found: C, 85.8; H, 7.45; mol. wt., 395.

(5) *p*-Acetoxypropiophenone.—The sirup which was left after distillation of the starting material was distilled in a high vacuum. Crystallization from butyl acetate gave beautiful prisms, m. p. 214° (III, $R = \text{COCH}_3$).⁷

Anal. Calcd. for $\text{C}_{22}\text{H}_{20}\text{O}_6$: C, 68.4; H, 6.7. Found: C, 68.5; H, 6.6.

(6) Stoermer and Schenck, *Ber.*, **61**, 2320 (1928).

(7) Dodds and co-workers (ref. 3) report a m. p. of 200°. Their pinacol may represent the other stereoisomer, although it was converted into the high-melting form of hexoestrol.

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The Iodination of Tyrosine by Iodine Monochloride

BY PAUL BLOCK, JR., AND GARFIELD POWELL

Tyrosine was first iodinated to diiodotyrosine by Wheeler and Jamieson¹ who added solid iodine to a solution of tyrosine in sodium hydroxide. Oswald² improved the yield by performing the reaction at 0°. More recently Harington³ and also Savitskii⁴ have described the iodination of tyrosine in ammonia using iodine dissolved in potassium iodide. Bauer and Strauss⁵ used iodine

(1) Wheeler and Jamieson, *Am. Chem. J.*, **33**, 365 (1905).

(2) Oswald, *Z. physik. Chem.*, **59**, 320 (1909).

(3) Harington, *Biochem. J.*, **22**, 1434 (1928).

(4) Savitskii, *Chem. Abs.*, **34**, 741 (1940).

(5) Bauer and Strauss, *Ber.*, **69**, 245 (1936).

monochloride vapor to synthesize diiodotyrosine in 38.5% yield. The following method gives 80 to 85% of a product that can more easily be rendered absolutely white than diiodotyrosine iodinated by the method of Oswald.

Five grams of tyrosine was suspended in 20 cc. of acetic acid, and 10 g. of iodine monochloride in 20 cc. of acetic acid added. The tyrosine immediately went into solution. The reaction mixture was warmed to 60° and 80 cc. of water added in three portions, warming the solution to 60° after each addition. The total time of heating was thirty minutes. Sodium bisulfite was added to destroy the excess iodine monochloride, and ammonia to precipitate the diiodotyrosine. One reprecipitation from dilute hydrochloric acid gave an entirely colorless product, decomposing with evolution of iodine at 201° (cor.), heated at 10° per minute.

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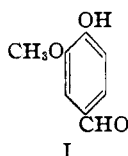
Some Derivatives of Creosol

By JOHN H. FLETCHER AND D. S. TARBELL

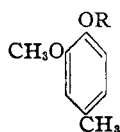
It was recently necessary to prepare 3,4-dimethoxy-5-propenyltoluene (VI) in connection with some other work. It seems worth while to report the observations and new compounds which resulted from the synthetic work.

The starting material was vanillin (I) from which creosol (II) was prepared by a Clemmensen reduction. This reaction has been reported by Kawai and Sugiyama,¹ but neither yields nor experimental details were given. These workers also carried out the synthesis of the allyl ether of creosol (III) and its subsequent rearrangement to 6-allylcreosol (IV); our work checks theirs. Methylation of IV followed by alkali-induced isomerization of the allyl side-chain in diethylene glycol solution produced 3,4-dimethoxy-5-propenyltoluene (VI). If IV was first isomerized and then methylated, VI was obtained but in poorer yield than by the former method. Compound VII, 6-propenylcreosol, is a solid, m. p. 61–62°; all the other derivatives described above are high-boiling liquids.

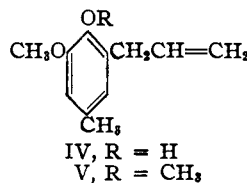
Two solid derivatives were prepared and ana-



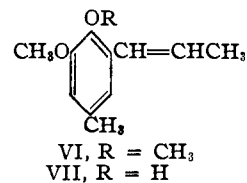
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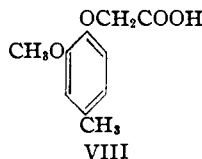
II, R = H
III, R = CH₂CH=CH₂



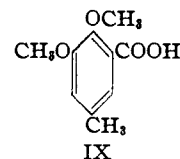
IV, R = H
V, R = CH₃



VI, R = CH₃
VII, R = H



VIII



IX

lyzed as checks. Oxidation of III gave 2-methoxy-4-methylphenoxyacetic acid (VIII); both V and VI gave 2,3-dimethoxy-5-methylbenzoic acid (IX) when treated with aqueous permanganate.

Experimental²

Creosol (II).—The modified procedure of Martin³ was used with the following amounts: 200 g. of mossy zinc, 150 cc. of water, 350 cc. of concentrated hydrochloric acid, 200 cc. of toluene, and 90 g. of vanillin (Eastman Kodak Company). This mixture was refluxed for twenty-four hours. The yield of creosol was 51.7 g. (63%), b. p. 105–106° (15 mm.), *n*^{20D} 1.5355.⁴

Creosol Allyl Ether (III).—To a solution of 50 g. (0.36 mole) of creosol in 180 cc. of acetone was added 90 cc. of water containing 18 g. (0.45 mole) of sodium hydroxide; after mixing well, 54.5 g. (0.45 mole) of allyl bromide was added and the mixture refluxed for one hour. Dilution was made with 500 cc. of water and the solution was extracted with three 90-cc. portions of petroleum ether (b. p. 60–70°). The ether extract was washed twice with 5% alkali, twice with water, and was dried over calcium chloride. The solvent was distilled and the residual oil subjected to vacuum distillation; yield, 55.4 g. (86%), b. p. 128–130° (15 mm.), *n*^{24D} 1.5270.

2-Methoxy-4-methylphenoxyacetic Acid (VIII).—A solution of 4.7 g. (0.03 mole) of potassium permanganate in 200 cc. of water was prepared. To this was added 1.3 g. (0.01 mole) of sodium carbonate monohydrate and 1.8 g. (0.01 mole) of creosol allyl ether (III). The mixture was shaken at intervals for fifteen minutes; heat was evolved and a brown solid separated. After standing overnight the mixture was filtered; the filtrate was acidified with hydrochloric acid and evaporated to 50 cc. On cooling, white crystals were obtained; yield, 0.6 g. (31%), m. p. 111–113°. The product was recrystallized from water; m. p. 115–116°.

Anal. Calcd. for C₁₀H₁₂O₄: C, 61.2; H, 6.2. Found: C, 61.3; H, 6.0.

6-Allylcreosol (IV).—Fifty-five grams of creosol allyl ether (III) was heated in an oil-bath to 210° whereupon gentle boiling set in and the liquid darkened. After five minutes the material was allowed to cool. It was distilled

(2) Analyses by Mr. Robert W. King.

(3) Martin, *THIS JOURNAL*, **58**, 1438 (1936).

(4) de Vries, *Rec. trav. chim.*, **28**, 283 (1909), gives for creosol *n*^{20D} 1.5353.

(1) Kawai and Sugiyama, *Ber.*, **72B**, 367 (1939).