Nitration of 2,6-Dibromo-4-fluorophenol.—Three grams of sodium nitrate was added during forty-five minutes, with stirring, to a solution of 5.9 g. of 2,6-dibromo-4-fluorophenol in 50 ml. of glacial acetic acid at 14–18°. After fifteen minutes the mixture was poured into water; then the precipitate was removed by filtration and dried. A yield of 72% was obtained. Recrystallization from chloroform gave yellow needles melting at 67°.

Anal. Calcd. for $C_6H_3O_3NBrF$: Br, 33.85. Found: Br, 34.07.

Nitration of 2-Fluoro-4,6-dibromophenol.—Two grams of sodium nitrate was added during an hour to 5.17 g. of this compound in constantly stirred glacial acetic acid solution. Fifteen minutes after the addition was complete the reaction mixture was poured into water. The precipitated solid was filtered off and steam-distilled to give 1.34 g. (32%) of the bright yellow *o*-nitro derivative, *viz.*, 2-fluoro-4-bromo-6-nitrophenol, m. p. 62°.

Anal. Calcd. for $C_6H_2O_3NBrF$: Br, 33.85. Found: Br, 34.19.

The solution from which the *o*-nitro compound had been precipitated was evaporated to a small volume and the residue concentrated further *in vacuo*. On dilution of the residue with a little water and cooling the para compound was precipitated. After crystallization from chloroform 1.03 g. (25%) of colorless granular crystals, m. p. 101°, was obtained.

Anal. Calcd. for $C_6H_2O_3NBrF$: Br, 33.85. Found: Br, 34.23.

Nitration of 2,4,6-Tribromo-3-fluorophenol.—A solution of 34.9 g. of this compound in 300 ml. of glacial acetic acid at 18° was treated with 10.5 g. of sodium nitrate which was added during the period of one hour. The reaction mixture was poured into water and steam-distilled as long as volatile material was carried over. The solid volatile product was collected and recrystallized several times from dilute alcohol to yield 20 g. (63%) of yellow needles melting at 76°.[5] Some starting material, 2.6 g. (7%), was recovered from the mother liquor.

Anal. Calcd. for $C_6H_2O_3NBr_2F$: Br, 50.74. Found: Br, 50.87.

The residue from the steam distillation was evaporated *in vacuo* to a small volume then diluted with a little water and cooled in an ice-bath. In this way a precipitate was obtained. After drying, the precipitate was extracted with chloroform. This extract yielded 2.5 g. (8%) of colorless granules melting at 122° with decomposition. These properties indicate the presence of the *p*-nitro isomer, *viz.*, 2,6-dibromo-3-fluoro-4-nitrophenol.

Anal. Calcd. for $C_6H_2O_3NBr_2F$: Br, 50.74. Found: Br, 50.57.

The bright yellow chloroform-insoluble residue (6.4 g., 17%) was found to be the hydrated sodium salt of the 4-nitro derivative.

Anal. Calcd. for $C_6HO_3NBr_2Na\cdot 2.5H_2O$: Br, 41.84; wt. loss at 110°, 11.78. Found: Br, 41.68; wt. loss, 11.08.

Nitration of 3-Fluoro-4,6-dibromophenol.—Thirty grams of the phenol in 60 ml. of glacial acetic acid was treated with 150 ml. of concd. nitric acid containing 6 ml. of concd. sulfuric acid. After an hour the reaction mixture was poured into water. After drying 35 g. (100%) of the product was obtained. It melted at 75.5°[6] and showed a depression of 10° when mixed with the 2,4-dibromo-3-fluoro-6-nitrophenol (see above).

Anal. Calcd. for $C_6H_2O_3Br_2NF$: Br, 50.74. Found: Br, 50.60.

Summary

When brominated by the Zincke method 2,4,6-tribromo-3-fluorophenol gives 2,4-dibromo-3-fluoro-6-nitrophenol and 2,6-dibromo-3-fluoro-4-nitrophenol; 2-fluoro-4,6-dibromophenol yields 2 fluoro-4-bromo-6-nitrophenol and 2-fluoro-4-nitro-6-bromophenol, and 2,6-dibromo-4-fluorophenol gives 2-bromo-4-fluoro-6-nitrophenol.

RECEIVED AUGUST 4, 1944

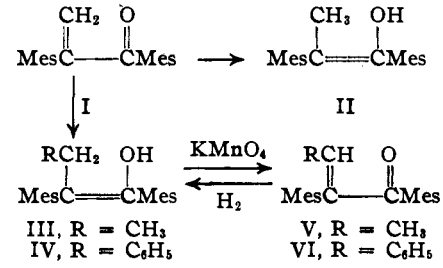
[CONTRIBUTION FROM THE NOYES CHEMICAL LABORATORY, UNIVERSITY OF ILLINOIS]

Vinyl Alcohols. XIV.[1] Condensation of Grignard Reagents with α,β-Unsaturated Ketones

BY REYNOLD C. FUSON, D. J. BYERS,[2] STANLEY P. ROWLAND,[3] PHILIP L. SOUTHWICK[4] AND CARLETON A. SPERATI

The formation of stable propenols by the addition of hydrogen to the corresponding α,β-unsaturated ketones[5] ought to be capable of extension to the addition of other typical carbonyl reagents. In the present work it has been shown that the Grignard reagent can be used.

By the condensation of mesityl α-mesitylvinyl ketone (I), with methylmagnesium iodide, for example, 1,2-dimesityl-1-buten-1-ol (III) was produced. It was characterized by conversion to an acetate and by oxidation. Potassium permanganate produced the corresponding unsaturated ketone (V). Oxygen cleaved the enol, yielding mesitoic acid and propiomesitylene. Hydrogenation of the butenone (V) regenerated the butenol (III).



A similar series of observations was made when phenylmagnesium bromide was used. The enol (IV) in this case was much more stable than was the analogous propenol without the phenyl group (II). Attempts to ketonize the phenylpropenol

(1) For the preceding communication in this series see Fuson, Armstrong, Kneisley and Shenk, THIS JOURNAL, **66**, 1464 (1944).

(2) Du Pont Post-doctorate Research Fellow, 1940–1941.

(3) Du Pont Fellow in Chemistry, 1942–1943.

(4) Abbott Fellow, 1942–1943.

(5) (a) Fuson, Corse and McKeever, THIS JOURNAL, **62**, 3250 (1940); (b) Fuson and Sperati, *ibid.*, **63**, 2643 (1941).

TABLE I

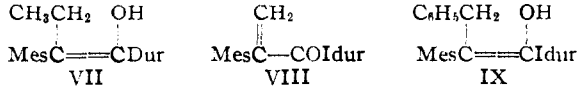
Compound	M. p., °C.	Recrystn. solvent	Molecular formula	Analyses, % Calcd. C	Calcd. H	Found[a] C	Found[a] H
CH_3CH_2 OH MesC=C$CMesCH_3OH$	69–70.5	Methanol	$C_{23}H_{32}O_2$	81.13	9.48	81.49	9.66
CH_3CH_2 $OCOCH_3$ MesC=C$CMes	155–156	Ethanol	$C_{24}H_{30}O_2$	82.23	8.63	82.13	8.82
CH_3CH O MesC—C$CMes	134.5–135.5	Ethanol	$C_{22}H_{26}O$	86.23	8.55	85.96	8.60
$C_6H_5CH_2$ OH MesC=C$CMes	140–141	Methanol	$C_{27}H_{30}O$	87.52	8.16	87.40	8.16
$C_6H_5CH_2$ $OCOCH_3$ MesC=C$CMes	138–139	Ethanol	$C_{29}H_{32}O_2$	84.42	7.82	84.45	7.98
C_6H_5CH O MesC—C$CMes	171.5–172.5	Methanol	$C_{27}H_{28}O$	88.00	7.66	87.94	7.63
CH_3CH_2 OH MesC=C$CDur	114–115 (cor.)	Ethanol	$C_{23}H_{30}O$	85.66	9.38	85.68	9.50
CH_3CH_2 $OCOCH_3$ MesC=C$CDur	155–156 (cor.)	Ethanol	$C_{25}H_{32}O_2$	82.37	8.85	82.77	8.91
CH_3CH O MesC—C$CDur	172–173 (cor.)	Ethanol	$C_{23}H_{28}O$	86.19	8.81	86.06	8.92
$C_6H_5CH_2$ OH MesC=C$CIdur	118.5–119.5	Methanol	$C_{28}H_{32}O$	87.45	8.39	87.58	8.37
$C_6H_5CH_2$ $OCOCH_3$ MesC=C$CIdur	133–134	Methanol	$C_{30}H_{34}O_2$	84.46	8.04	84.68	7.93
$C_6H_5CH_2$ $OCOC_6H_5$ MesC=C$CIdur	184.5–185.5[b]	Absolute ethanol	$C_{35}H_{36}O_2$	86.02	7.43	86.11	7.58

[a] The analyses reported in this paper were carried out by Miss Margaret McCarthy, Miss Theta Spoor and Miss Dorothy Schneider. [b] The melting point varied in a way which suggested that the ester formed two different crystalline modifications. The sample used for analysis was that having the highest melting point observed.

(IV) by heating with methanolic hydrogen chloride were without effect.

1-Duryl-2-mesityl-1-buten-1-ol (VII) was made from duryl α-mesitylvinyl ketone[5b] and methylmagnesium iodide. It formed an acetate and could be oxidized to the corresponding butenone. Hydrogenation of the butenone reconverted it to the enol.

The condensation of phenylmagnesium bromide with isoduryl α-mesitylvinyl ketone (VIII)[5b] yielded a propenol (IX) which was very similar to the dimesityl analog (VI). Treatment of an acetone solution of the isodurylpropenol (IX) with oxygen for seventy-two hours resulted in partial cleavage with the production of isodurenol. This unusual type of oxidative cleavage has been encountered in earlier work.[6] The cleavage was, however, much more difficult to bring about than with the dimesitylpropenol (II). The essential difference between the two enols is the crowding at the *beta* position provided by the phenyl group.



Experimental

The procedures employed in the preparation of the dimesitylbutenol (III) and its derivatives will serve to illustrate the synthetic methods used in this work. The melting points, recrystallization solvents and analytical data for the new compounds are listed in the table.

1,2-Dimesityl-1-buten-1-ol (III).—To a refluxing solution of the Grignard reagent, made from 20.2 g. of methyl iodide in 75 cc. of ether, was added dropwise a solution of 10 g. of mesityl α-mesitylvinyl ketone[5a] in 150 cc. of benzene. The reaction mixture was heated under reflux for an additional three hours and decomposed with ice and hydrochloric acid. Removal of the solvent from the organic layer left the butenol as a white solid.

To prepare the **acetate** a solution of 0.5 g. of the butanol, 5 cc. of acetic anhydride and one drop of concentrated sulfuric acid was heated under reflux for thirty minutes and poured on ice.

1,2-Dimesityl-2-buten-1-one (V).—To a solution of 2 g. of 1,2-dimesityl-1-buten-1-ol in 40 cc. of acetone was added gradually, with stirring, a 1% solution of potassium permanganate in acetone until the pink color persisted. The manganese dioxide was removed by filtration and the solvent evaporated.

Hydrogenation of the unsaturated ketone in glacial acetic acid and in the presence of a platinum oxide catalyst regenerated the butenol.

Cleavage of 1,2-Dimesityl-1-buten-1-ol by Oxygen.—Oxygen was bubbled for sixty hours through a solution of 5 g. of the butenol in 100 cc. of ligroin. The solvent was replaced as needed. The mixture was extracted four times with 5% sodium hydroxide solution. Acidification of the alkaline solution produced a white solid which proved to be mesitoic acid. The ligroin solution was washed with water and dried. Fractional distillation yielded 1.7 g. of propiomesitylene, b. p. 114–116° (10 mm.). It was identified by nitration, which converted it to the known dinitropropiomesitylene; m. p. 144–145°.

Attempted Ketonization of 1,2-Dimesityl-3-phenyl-1-propen-1-ol (IV).—A solution of 1 g. of 1,2-dimesityl-3-phenyl-1-propen-1-ol in 150 cc. of methanol was saturated with dry hydrogen chloride. It was heated under reflux for thirty-six hours, during which time the passage of hydrogen chloride into the solution was continued. The vinyl alcohol was recovered unchanged.

Saponification of the Acetate of 1-Isoduryl-2-mesityl-3-phenyl-1-propen-1-ol (IX).—This reaction was effected by heating 0.5 g. of the acetate for one-half hour with a solution of 1 g. of sodium in 40 cc. of absolute ethanol. The hydrolysis product, recrystallized from methanol, melted at 116.5–118° and did not depress the melting point when mixed with the original enol.

Cleavage of 1-Isoduryl-2-mesityl-3-phenyl-1-propen-1-ol.—Seven grams of the enol was dissolved in 300 cc. of

(6) Fuson, Byers, Rachlin and Southwick, THIS JOURNAL, 64, 2886 (1942).

acetone and oxygen was bubbled through the solution for three days, acetone being added from time to time to replace that lost by evaporation. The solvent was evaporated and the solid residue extracted with a solution of potassium bicarbonate. Acidification of the carbonate solution, however, yielded no organic acid. Extraction of the residue with 5% sodium hydroxide yielded isodurenol melting at 78–79°.[7] The only compound which was isolated from the neutral fraction was unchanged enol (4.4 g.).

(7) Hey, *J. Chem. Soc.*, 1590 (1931).

Summary

It has been shown that stable vinyl alcohols can be made by the condensation of Grignard reagents with suitable α,β-unsaturated ketones.

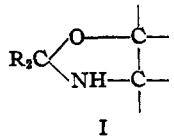
URBANA, ILLINOIS RECEIVED JULY 3, 1944

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, COLUMBIA UNIVERSITY]

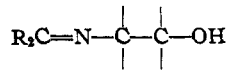
Condensation Products of Aldehydes and Ketones with *o*-Aminobenzyl Alcohol and *o*-Hydroxybenzylamine

BY FREDERICK W. HOLLY AND ARTHUR C. COPE

The condensation products of ketones with ethanolamine and other 1,2-alkanolamines have been shown to be oxazolidines (I) or azomethines (Schiff bases) (II), depending on the structure of the ketone.[1]



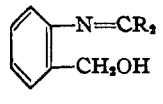
I



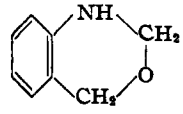
II

In general, the anhydro compounds derived from reactive, unhindered ketones proved to be oxazolidines, while corresponding compounds obtained from the sterically hindered diisobutyl ketone were azomethines. Interconversion of the two forms was evident for the condensation product of methyl propyl ketone with ethanolamine, which rapidly established an equilibrium between the two structures (I ⇄ II) by ring-chain tautomerism. In other cases molecular refraction data indicated a predominance of one form, but did not exclude the possibility that the other was present in smaller amount. Similar observations have been made concerning the structure of anhydro compounds obtained from ketones and 3-amino-1-propanol.[2] The present paper is concerned with the structure of condensation products of aldehydes and ketones with *o*-aminobenzyl alcohol and *o*-hydroxybenzylamine.

Paal and Laudenheimer[3] have described the condensation products of acetone and a number of aldehydes with *o*-aminobenzyl alcohol as azomethines (III), and did not consider a possible cyclic structure (IV).



III



IV

(1) Cope and Hancock, THIS JOURNAL, 64, 1503 (1942); 66, 1453 (1944); Hancock and Cope, *ibid.*, 66, 1738 (1944).

(2) Hancock, Hardy, Heyl, Wright and Cope, *ibid.*, 66, 1747 (1944).

(3) Paal and Laudenheimer, *Ber.*, 25, 2967 (1892).

They obtained amorphous products from *o*-aminobenzyl alcohol and formaldehyde or methylal, while methyl ethyl ketone and less reactive ketones failed to condense.

We have condensed *o*-aminobenzyl alcohol with a number of aldehydes and ketones by refluxing the reactants in benzene solution, and removing the water continuously as it formed. Glacial acetic acid was added as a catalyst except with aldehydes, acetone and cyclohexanone, which required no catalyst. Properties of the condensation products are listed in Table I. Evidence for their structure has been obtained by absorption spectrum and molecular refraction measurements.

Ultraviolet absorption spectra of compounds 3, 4, 5 and 11 (Table I) are shown in Figs. 1 and 2. Each has the two absorption maxima characteristic of a secondary aromatic amine, at 2940–2975 Å. (log ϵ 3.34–3.20) and 2445–2450 Å. (log ϵ 3.96–3.72). These wave lengths and extinction coefficients correspond closely to the data for N-ethyl-*o*-toluidine (Fig. 1), which has maxima at 2910 Å. (log ϵ 3.39) and 2440 Å. (log ϵ 3.86). The 2-phenyl derivative (12, Table I) has a maximum at 2450 Å. (log ϵ 3.93) and an inflection point at

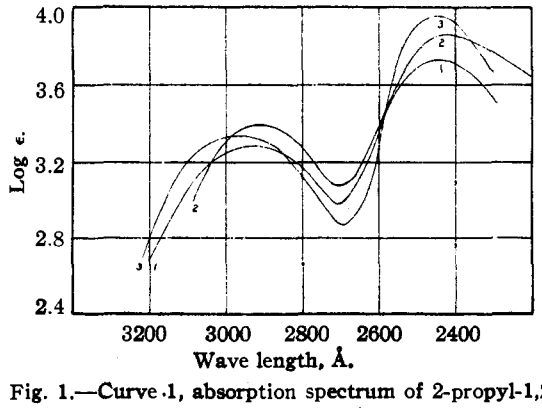


Fig. 1.—Curve 1, absorption spectrum of 2-propyl-1,2-dihydro-3,1,4-benzoxazine (3, Table I); curve 2, N-ethyl-*o*-toluidine; curve 3, spiro-[cyclohexane-2-(1,2-dihydro-3,1,4-benzoxazine)] (11, Table I).