With a molar ratio of diethylamine and formaldehyde to phenol of 3.5 to 1, it appeared that appreciable amounts of mono- and di-substituted phenols were formed.[6]

***o*-, *m*- and *p*-Cresol.**—Preparation of the three cresols was based on the conversion of *m*-nitroaniline to *m*-nitrophenol which is described in "Organic Syntheses."[7]

A cold solution of 120 cc. of water and 80 cc. of concd. sulfuric acid was stirred by hand while 43 g. (0.4 mole) of *p*-toluidine and then 200 g. of finely crushed ice were added. A solution of 27 g. of sodium nitrite dissolved in 125 cc. of water was added rapidly (15–20 min.) from a separatory funnel whose stem was immersed below the surface of the liquid. The temperature during the diazotization was maintained between 0 and 5°. Urea (2 g.) was added and stirring was continued for ten minutes.

While diazotization was in progress, 270 cc. of concd. sulfuric acid was added to 200 cc. of water in a 2-liter, round-bottomed flask. The acid was heated to boiling and the diazonium solution was then added at such a rate that the acid mixture was kept boiling vigorously. The *p*-cresol was steam-distilled and extracted with ether from the distillate. The ether extract was dried over magnesium sulfate, the ether evaporated, and the *p*-cresol distilled at atmospheric pressure. It boiled at 195–200°; yield 20 g. (46%).

By a similar synthesis, *o*-cresol, b. p. 69–71° (6 mm.), was made in 40.1% yield, and *m*-cresol, b. p. 80–82° (6 mm.), in 41.2% yield.

**2-(Diethylaminomethyl)-4-methylphenol.**—Fifty-four grams (75%) of this compound was obtained when 40 g. (0.46 mole) of *p*-cresol was condensed with 37.2 g. (0.51 mole) of diethylamine, and 43.7 g. (0.51 mole) of formalin. It was a pale amber oil, b. p. 90–93° (1–2 mm.); $d^{25}_4$ 0.9675; $n^{25}_D$ 1.5140; *MR* calcd. 59.65; found, 60.21.

*Anal.* Calcd. for $C_{12}H_{19}NO$: N, 7.25. Found: N, 7.09, 7.12.

**2-(Diethylaminomethyl)-6-methylphenol.**—From 21.4 g. (0.20 mole) of *o*-cresol, 15.8 g. (0.22 mole) of diethylamine and 19 g. (0.22 mole) of formalin, there resulted 22 g. (57.7%) of the phenol boiling at 93–97° (1–2 mm.); $d^{25}_4$ 0.9708; $n^{25}_D$ 1.5141; *MR* calcd. 59.65; found, 59.95.

*Anal.* Calcd. for $C_{12}H_{19}NO$: N, 7.25. Found: N, 7.23, 7.21.

**2- or 6-(Diethylaminomethyl)-3-methylphenol.**—Eighteen grams (0.17 mole) of *m*-cresol was condensed with 13.4 g. (0.18 mole) of diethylamine and 15.8 g. (0.18 mole) of formalin to yield 13 g. (40.4%) of a fraction which boiled at 107–110° (1–2 mm.); $d^{25}_4$ 0.9677; $n^{25}_D$ 1.5130; *MR* calcd. 59.65; found 60.03.

*Anal.* Calcd. for $C_{12}H_{19}NO$: N, 7.25. Found: N, 7.40, 7.42.

There is not yet sufficient evidence to indicate whether the entering group occupies the 2- or the 6-position.

## Summary

1. Diethylamine and formaldehyde have been condensed with phenol and with *o*-, *m*- and *p*-cresol; 2-diethylaminomethylphenol, 6-diethylaminomethyl-2-methylphenol, 2- or 6-diethylaminomethyl-3-methylphenol and 2-diethylaminomethyl-4-methylphenol, respectively, were formed.

2. 2,6-Di-(diethylaminomethyl)-phenol was isolated when an excess of diethylamine and formaldehyde was condensed with phenol.

LEXINGTON, KENTUCKY RECEIVED JUNE 29, 1945

---

(6) Bruson and MacMullen (ref. 3d) have reported the formation of 2,4,6-tri-(dimethylaminomethyl)-phenol in 86% yield under conditions similar to those which we used. Dimethylamine, formaldehyde and phenol were employed in a molar ratio of 4, 3.5 and 1 in their experiment.

(7) Gilman, "Organic Syntheses," Coll. Vol. I, John Wiley and Sons, Inc., New York, N. Y., 1932, p. 396.

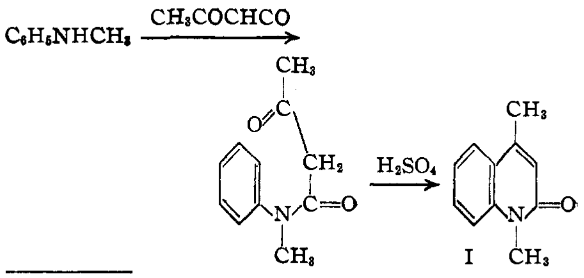
---

[CONTRIBUTION FROM THE CHEMISTRY LABORATORY OF INDIANA UNIVERSITY]

# N-Substituted 4-Methylcarbostyrils[1]

BY C. E. KASLOW AND D. J. COOK[2,3]

A study has been made of the preparation of N-alkyl-4-methylcarbostyrils by the reaction between a secondary aromatic amine and ketene dimer. The reaction is illustrated by the following equation showing the formation of 1,4-dimethylcarbostyril.



I

1,4-Dimethylcarbostyril has been prepared by Knorr[4] through rearrangement of 2-methoxylepidine and also by treating the crude condensation product of methylaniline and acetoacetic ester with sulfuric acid.

The above synthesis has made available several 1-alkyl-4-methylcarbostyrils which may be obtained in yields of 44–83% (see Table II of Experimental).

A study has also been made of some reactions of 1,4-dimethylcarbostyril which was chosen as a typical representative of this class of compounds. For example, the nitration of 1,4-dimethylcarbostyril with excess fuming nitric acid gave a mixture from which a mononitro- and a trinitro-compound was isolated. On the basis of previous work on the nitration of 1-methylcarbostyril[5,6] these compounds may be tentatively assigned the structures of 6-nitro- and 3,6,8-trinitro-1,4-dimethylcarbostyril.

---

(1) Presented in part before the Division of Organic Chemistry, American Chemical Society, New York, N. Y., September 13, 1944.

(2) Abstracted from a thesis submitted to the Faculty of the Graduate School in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the Department of Chemistry, Indiana University.

(3) Present address: DePauw University, Greencastle, Indiana.

(4) Knorr, *Ann.*, **236**, 69 (1886).

(5) Decker, *J. prakt. Chem.*, **64**, 85 (1901).

(6) Kaufman and dePetherd, *Ber.*, **50**, 336 (1916).

TABLE I

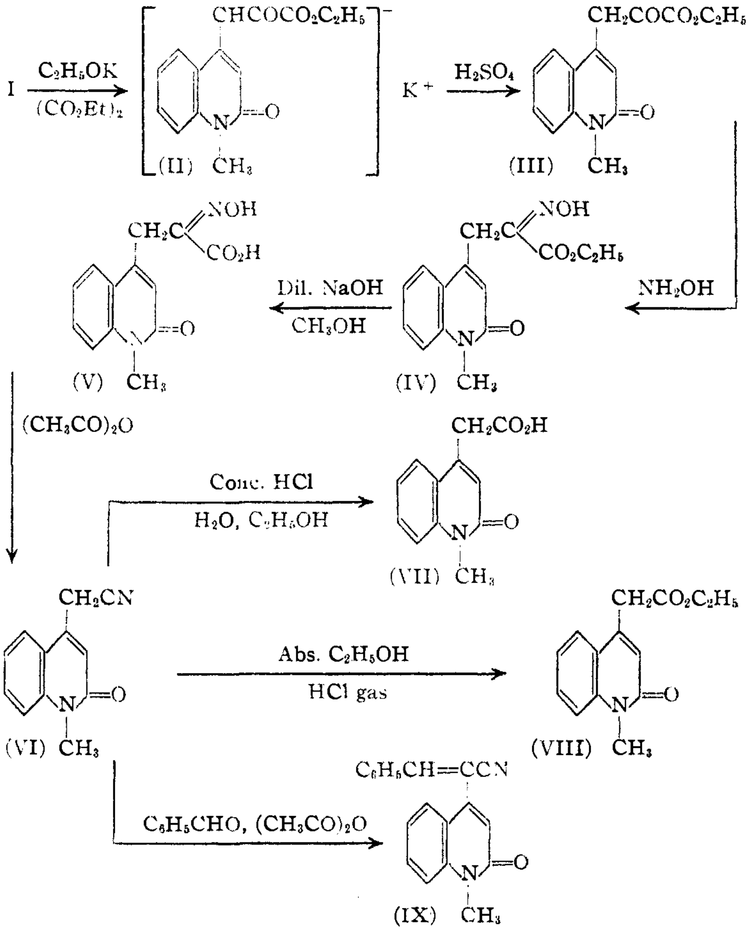
ACETOACETANILIDES OF THE TYPE, $CH_3COCH_2CON(R)C_6H_5$

| R— | B. p. °C. | B. p. mm. | Yield, % | 2,4-Dinitrophenylhydrazone M. p., °C. | Empirical formula | N Analyses, % Calcd. | N Analyses, % Found |
|---|---|---|---|---|---|---|---|
| Methyl | 130–132 | 4 | 68.6 | 120.5–121 | $C_{17}H_{17}N_5O_5$ | [a] | |
| Ethyl | 107–108 | 0.5 | 90.0 | 125–126 | $C_{18}H_{19}N_5O_5$ | 18.20 | 18.67 |
| *n*-Butyl | 162–165 | 5 | 64.5 | 124.5–125 | $C_{20}N_{23}N_5O_5$ | 16.95 | 17.34 |
| Benzyl | 170–175 | 5 | 35.0 | 122–123 | $C_{23}H_{23}N_5O_5$ | 15.66 | 15.35 |
| Allyl | 148–150 | 7 | 63.5 | 118–119.5 | $C_{19}H_{19}N_5O_5$ | 17.63 | 17.38 |

[a] *Anal.* Calcd. for $C_{17}H_{17}N_5O_5$: C, 54.99; H, 4.62. Found: C, 55.6; H, 5.01.

Even though benzaldehyde would not condense with 1,4-dimethylcarbostyril, ethyl oxalate condensed with it in the presence of potassium ethoxide to produce the keto-ester (III) (see Chart I) in yields of 65–71%. This keto-ester did not decarbonylate when heated with powdered soft glass and attempted hydrolysis with dilute sodium hydroxide cleaved it to the original carbostyril. However, it reacted with hydroxylamine to produce the oximino-ester (IV) which on hydrolysis gave the oximino acid (V). When this latter substance was heated with acetic anhydride, carbon dioxide and water were eliminated to produce the nitrile (VI). This nitrile can be hydrolyzed to the acid (VII) or converted to the ester (VIII) and also condensed with benzaldehyde in the presence of acetic anhydride to give the benzal derivative (IX). This series of reactions serves as a useful method for the synthesis of 1-alkyl carbostyrils with substituents in position 4.

CHART I



## Experimental[7]

**N-Substituted Anilines.**—Methyl-, ethyl-, *n*-propyl-, *n*-butyl-, and *n*-amylaniline were Eastman Kodak Company products. Benzyl- and allylaniline were prepared according to the method described by Willson and Wheeler.[8]

The preparation of N-ethylacetoacetanilide and 1,4-dimethylcarbostyril illustrate the general method used for the synthesis of the N-alkylacetoacetanilides and the 1-alkyl-4-methylcarbostyrils.

**N-Ethylacetoacetanilide.**—Twenty-five grams (0.3 mole) of diketene was added dropwise to 31.4 g. (0.26 mole) of ethylaniline contained in a 200-ml., three-necked, round-bottomed flask equipped with a reflux condenser, mechanical stirrer, dropping funnel and a thermometer. The ethylaniline had been warmed previously to 90° and the rate of addition was regulated so as to maintain the temperature of the reaction mixture at 100–105°. After addition of the diketene, the reaction mixture was heated in a boiling water-bath for one hour. The crude N-ethylacetoacetanilide was dissolved in 100 ml. of ether and shaken with 35 ml. of 10% sodium carbonate solution to remove the dehydroacetic acid. The ether solution was dried with 6 g. of anhydrous magnesium sulfate, the ether removed by distillation at atmospheric pressure and the residual oil was vacuum distilled. After a forerun of about 1 ml. had been collected, the substance distilled at 107–108° (0.5 mm.). The yield was 48 g. (90%). The other N-alkylacetoacetanilides reported in Table I were prepared in an analogous manner. N-Ethyl- and N-methylacetoacetanilide have been reported by Chaplin and Hunter[9] who isolated the sodium and copper salts of the substances and reported their analyses.

**N-Alkyl Acetoacetanilide 2,4-Dinitrophenylhydrazone.**—The 2,4-dinitrophenylhydrazones of the N-alkylacetoacetanilides were prepared according to the general directions given by Shriner and Fuson[10] and were purified by

---

(7) All melting points are corrected.

(8) Willson and Wheeler, "Organic Syntheses," Coll. Vol. I, 2nd ed., John Wiley and Sons, Inc., New York, N. Y., 1941, p. 102.

(9) Chaplin and Hunter, *J. Chem. Soc.*, 484 (1939).

(10) Shriner and Fuson, "Identification of Organic Compounds," 2nd ed., John Wiley and Sons, Inc., New York, N. Y., 1943, p. 143.

TABLE II

1-ALKYL-4-METHYLCARBOSTYRILS

| Substituent position 1 | B. p. °C. | mm. | Yield, % | Empirical formula | N Analyses, % Calcd. | Found | Picrate, m. p., °C. |
|---|---|---|---|---|---|---|---|
| Ethyl | 135–136 | 0.5 | 83.1 | $C_{12}H_{13}NO$ | 7.38 | 7.34 | 160.5–161.5 |
| *n*-Propyl | 155–156 | 2 | 58 | $C_{13}H_{15}NO$ | 6.96 | 6.89 | 112–113.5 |
| *n*-Butyl | 170–171 | 3 | 72 | $C_{14}H_{17}NO$ | 6.51 | 6.34 | 105–106 |
| *n*-Amyl | 175–176 | 1 | 74 | $C_{15}H_{19}NO$ | 6.11 | 6.08 | 110–111.5 |
| | M. p., °C. | | | | | | |
| Allyl | 72–73 | | 44 | $C_{13}H_{13}NO$ | 7.03 | 7.15 | |
| Benzyl | 110.5–111.5 | | 58 | $C_{17}H_{15}NO$ | 5.62 | 5.52 | 132–133 |
| Methyl | 129.5–130.5 | | 83.4 | $C_{11}H_{11}NO$ | | | 157.5–158 |

recrystallization from ethyl alcohol. Their melting points and analyses are given in Table I.

**1,4-Dimethylcarbostyryl (I).**—Eighty-one grams (0.75 mole) of methylaniline was added to a 500-ml., three-necked, round-bottomed flask fitted with a mechanical stirrer and a reflux condenser. The methylaniline was heated on the steam-bath and 93 g. (1.1 moles) of diketene added dropwise with constant stirring. The reaction mixture was heated on the steam-bath for an additional two hours. After cooling to room temperature, the reaction mixture was added in approximately 5-ml. portions to 150 ml. of concentrated sulfuric acid which was stirred mechanically. The temperature was maintained at about 75°. The sulfuric acid solution was finally heated on the steam-bath for ten to fifteen minutes after the evolution of gas had ceased. After cooling to room temperature, the reaction mixture was poured, with vigorous stirring, into 1500 ml. of ice-water, the solution neutralized with sodium hydroxide and allowed to stand overnight. The solid was collected on a filter, dried at 70–75° and the crude substance extracted with 600 ml. of benzene, filtered and the hot filtrate diluted with 200 ml. of hot ligroin (b. p. 70–80°). The 1,4-dimethylcarbostyril was obtained as short, thick, white needles; yield 107.2 g. (83.4%), m. p. 127–129°. Recrystallization raised the melting point to 129.5–130.5°. The melting point reported by Knorr[4] is 130–132°.

The other 1-alkyl-4-methylcarbostyrils were prepared in an analogous manner. If the carbostyril was a liquid substance, it was extracted with ether, the solution dried with anhydrous magnesium sulfate, the ether removed by distillation at atmospheric pressure and the residue vacuum distilled. The results are summarized in Table II. The over-all yield of the 1-alkyl-4-methylcarbostyril was much lower if the N-alkylacetoacetanilide was isolated and purified before treatment with sulfuric acid.

**1-Alkyl 4-Methylcarbostyril Picrate.**—The picrates were prepared according to the general directions given by Shriner and Fuson[11] and were purified by recrystallization from ethyl alcohol. The melting points of the picrates are given in Table II.

**Ethyl 1-Methyl-4-carbostyrilpyruvate (III).**—A solution of 22 g. (0.15 mole) of ethyl oxalate in 20 ml. of anhydrous benzene was added to an ice-cold solution of 11.8 g. (0.3 mole) of potassium in 50 ml. of absolute ethyl alcohol in a 500-ml., round-bottomed flask. After cooling in an ice-bath for ten minutes, a solution of 25 g. (0.144 mole) of I in 150 ml. of anhydrous benzene was added, the flask corked tightly and allowed to stand at room temperature for twenty-four hours. The dense yellow precipitate of the potassium salt (II) was removed by filtration, washed with two 30-ml. portions of benzene and allowed to dry. The dry solid was transferred to a 600-ml. beaker and warmed for twenty minutes with 150 ml. of 6% sulfuric acid to convert the salt to the free ester (III); yield 28 g. (71%), m. p. 181.5–183°. Recrystallization from 95% ethyl alcohol gave fine white needles but there was no change in the melting point.

*Anal.* Calcd. for $C_{15}H_{15}NO_4$: N, 5.13. Found: N, 4.71.

**Ethyl 1-Methyl-4-carbostyrilpyruvate Phenylhydrazone.**—Five grams (0.018 mole) of the ester (III) was dissolved in 200 ml. of boiling 95% ethyl alcohol in a 500-ml., round-bottomed flask, 5 g. of phenylhydrazine hydrochloride in 50 ml. of ethyl alcohol was added and the solution refluxed for twenty minutes; yield 4.7 g. An additional 1 g. of hydrazone was obtained by concentration of the alcohol filtrate; total yield 87%. The substance was recrystallized from 95% ethyl alcohol yielding fine white needles; m. p. 220–221°.

*Anal.* Calcd. for $C_{21}H_{21}N_3O_3$: N, 11.56. Found: N, 11.22.

**Ethyl 1-Methyl-4-carbostyrilpyruvate 2,4-Dinitrophenylhydrazone.**—This substance was prepared from 2 g. of III according to the directions of Shriner and Fuson.[10] The 2,4-dinitrophenylhydrazone was recrystallized from an ethyl acetate-methyl alcohol (2:1) solution as yellow needles; m. p. 203–205°.

*Anal.* Calcd. for $C_{21}H_{19}N_5O_7$: N, 15.45. Found: N, 15.56.

**1-Methyl-4-carbostyrilpyruvic Acid.**—Twenty grams (0.0373 mole) of III was refluxed with 700 ml. of 6% sulfuric acid solution in a 1000-ml., round-bottomed flask for four hours. After neutralization with ammonium hydroxide, the solution was allowed to stand in a refrigerator overnight. The acid was obtained as fine white needles; yield 16.3 g. (91%). The substance was recrystallized from a water-glacial acetic acid mixture (5:2); m. p. 231–233° (dec.).

*Anal.* Calcd. for $C_{13}H_{11}NO_4$: N, 5.71. Found: N, 5.86.

**1-Methyl-4-carbostyrilpyruvic Acid 2,4-Dinitrophenylhydrazone.**—The 2,4-dinitrophenylhydrazone was prepared according to the general method previously mentioned[10] and was recrystallized from ethyl acetate; m. p. 274–275°.

*Anal.* Calcd. for $C_{19}H_{15}N_5O_7$: N, 16.47. Found: N, 15.81.

**Ethyl α-Oximino-1-methyl-4-carbostyrilpropionate, IV.**—Twenty-five grams (0.092 mole) of III and 25 g. (0.36 mole) of hydroxylamine hydrochloride were added to 250 ml. of mixture of pyridine and absolute ethyl alcohol (1:1) in a 500-ml. round-bottomed flask and heated on the steam-bath three hours. The solvent was removed by distillation at atmospheric pressure, then the residue triturated with 125 ml. of ice-cold water, filtered and washed with water; yield 24.5 g. (92.5%), m. p. 187–190°. Crystallization from 95% ethyl alcohol gave a white granular solid; m. p. 196.5–197.5°.

*Anal.* Calcd. for $C_{15}H_{16}N_2O_4$: C, 62.5; H, 5.56. Found: C, 62.9; H, 5.67.

**α-Oximino-1-methyl-4-carbostyrilpropionic Acid, V.**—A suspension of 19.6 g. (0.068 mole) of IV in 80 ml. of methyl alcohol and 160 ml. of 2 *N* sodium hydroxide solution was refluxed for 1.5 hours. After cooling in ice-water and neutralization with glacial acetic acid (32 ml.), the oximino acid precipitated as a white granular solid; yield 13.7 g. (77.5%), m. p. 192–194° (dec.). The substance was purified by precipitation from a dilute sodium hydroxide solution with acetic acid; m. p. 203–203.5° (dec.).

---

(11) Shriner and Fuson, Ref. 10, p. 149.

*Anal.* Calcd. for $C_{13}H_{12}N_2O_4$: N, 10.77. Found: N, 10.64.

**1-Methyl-4-carbostyrilacetonitrile** (VI).—Fourteen grams (0.054 mole) of V was warmed with 100 ml. of acetic anhydride in a 500-ml. round-bottomed flask. Evolution of carbon dioxide started at 30–35° and had ceased at 75–80°. After removal of the acetic anhydride in vacuum, the residual solid was crystallized as fine white needles from a solution of 100 ml. of acetone in 200 ml. of benzene; yield 7.2 g. (67.3%), m. p. 186.5–187.5°.

*Anal.* Calcd. for $C_{12}H_{10}N_2O$: N, 14.14. Found: N, 14.66.

**1-Methyl-4-carbostyrilacetic Acid** (VII).—Five grams (0.025 mole) of VI was refluxed with a mixture of 95% ethyl alcohol (45 ml.) and concentrated hydrochloric acid (45 ml.) for eight hours. After removal of most of the alcohol by evaporation on a steam-bath and cooling the residual solution in ice, a white granular solid separated. The solid was dissolved in 10% sodium carbonate solution and reprecipitated by neutralization with 6*N* hydrochloric acid; yield 4.2 g. (79%). The acid (VII) was recrystallized from a benzene–ether (3:2) solution; m. p. 185.5–186.5° (dec.).

*Anal.* Calcd. for $C_{12}H_{11}NO_3$: N, 6.45. Found: N, 6.35.

**Ethyl 1-Methyl-4-carbostyrilacetate** (VIII).—A solution of 2 g. (0.01 mole) of VI in 50 ml. of absolute ethyl alcohol was heated to reflux temperature and dry hydrogen chloride passed into the solution for three hours. The alcohol was removed by evaporation on a steam-bath then the solid residue was treated with 100 ml. of water, neutralized with sodium carbonate and extracted with ether. After drying, the ether was evaporated and the residue extracted with 100 ml. of a boiling mixture (1:1) of benzene and ligroin (b. p. 70–80°). The insoluble portion (1.2 g.) proved to be VI. Concentration of the solution gave a 0.6 g. yield of the ester (VIII); white needles, m. p. 94–95°.

*Anal.* Calcd. for $C_{14}H_{15}NO_3$: N, 5.71. Found: N, 6.26.

**1-Methyl-4-($\alpha$-cyanostyryl)-carbostyril** (IX).—A mixture of 1 g. (0.005 mole) of VI, 1 g. (0.01 mole) of benzaldehyde and 5 ml. of acetic anhydride was heated in an oil-bath at 140–150° for twelve hours. The solution was poured into 50 ml. of water, neutralized with sodium hydroxide and the solid which precipitated was crystallized from 10 ml. of 95% ethyl alcohol giving a white flocculent solid; yield 0.2 g. (14%). Two recrystallizations from alcohol gave a product which melted at 231.5–232.5°.

*Anal.* Calcd. for $C_{19}H_{14}N_2O$: N, 9.79. Found: N, 9.70.

**Nitration of 1,4-Dimethylcarbostyril** (I).—Fifteen grams (0.087 mole) of I was dissolved in 36 ml. of concentrated sulfuric acid contained in a 500-ml. three-necked round-bottomed flask fitted with a mechanical stirrer and a dropping funnel. The solution was cooled to 5° and 15 g. (0.23 mole) of fuming nitric acid (sp. gr. 1.5) in 10 g. of concentrated sulfuric acid added dropwise while the solution was stirred. The temperature was maintained at 5–10°. After addition of the mixed acids, the solution was allowed to stand for two hours at 10° and finally at room temperature for twelve hours. The nitration mixture was poured onto 300 g. of chipped ice; yield 13 g.

(a) **Isolation of the Mononitro Derivative.**—Nine and one-half grams of the crude nitro compound was extracted with 150 ml. of a hot benzene–acetone solution (1:1), filtered and the filtrate cooled in an ice-bath; yield 3.7 g. (39%), m. p. 218–220°. Pale yellow needles were obtained after two recrystallizations of the nitro compound from the benzene–acetone solution; m. p. 228.5–229°.

*Anal.* Calcd. for $C_{11}H_{10}N_2O_3$: N, 12.84. Found: N, 13.1, 12.94.

(b) **Isolation of the Trinitro Derivative.**—The benzene–acetone filtrate from (a) was evaporated to dryness, then the residue extracted with 100 ml. of boiling 95% ethyl alcohol and filtered. The alcohol-insoluble solid (2.5 g.) was crystallized from 100 ml. of boiling xylene as a finely divided yellow solid; m. p. 204–205°. Recrystallization from 20 ml. of an acetone–ethyl alcohol (1:1) solution gave bright yellow platelets; m. p. 207–208.5°.

*Anal.* Calcd. for $C_{11}H_8N_4O_7$: C, 42.86; H, 2.6; N, 18.18. Found: C, 43.0, 43.0; H, 2.87, 3.24; N, 18.3.

## Summary

1. Satisfactory methods have been described for the use of diketene and a secondary alkyl aromatic amine in the preparation of N-alkylacetoacetanilides and conversion of the latter substances to 1-alkyl-4-methylcarbostyrils.

2. The condensation of 1,4-dimethylcarbostyril with ethyl oxalate has been described and the synthesis of several compounds from ethyl 1-methyl-4-carbostyrilpyruvate has been given.

3. The nitration of 1,4-dimethylcarbostyril has been described.

BLOOMINGTON, INDIANA RECEIVED AUGUST 23, 1945

---

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF NORTHWESTERN UNIVERSITY]

# The Glycosylation of Hydrocarbons by Means of the Grignard Reagent

BY CHARLES D. HURD AND WILLIAM A. BONNER[1]

In previous communications[2] it has been demonstrated that reaction may be brought about between sugar derivatives and aromatic hydrocarbons in the presence of aluminum chloride. Reaction of benzene, for example, with either glucose pentaacetate or tetraacetylglucosyl chloride gives rise to tetraacetylglucosylbenzene and 1,1-diphenyl-1-desoxyglucitol. It was assumed that the glucose type of configuration was retained in the reaction products. Proof of this assumption is now presented by synthesizing one of these same compounds by means of the Grignard reagent under such conditions that isomerization could not occur. As a matter of fact, it would not have been unreasonable to assume that inversion might have occurred in the presence of aluminum chloride in view of the results of Hudson and collaborators[3] on the synthesis of heptaacetylneolactosyl chloride from lactose octaacetate and a mixture of aluminum chloride and phosphorus pentachloride. The glucose portion of lactose rearranges to an altrose unit during this process.

The basis for assuming that tetraacetylglucosyl

---

[1] Corn Products Co. Research Fellow, 1941–1944.

[2] Hurd and Bonner, THIS JOURNAL, **67**, **1664**, 1759 (1945).

[3] Hudson, *ibid.*, **48**, 2002 (1926); Kunz and Hudson, *ibid.*, **48**, 1978, 2435 (1926); Richtmyer and Hudson, *ibid.*, **57**, 1716 (1935); Hockett and Chandler, *ibid.*, **66**, 627 (1944).