mole) of potassium iodide. The whole reaction mass was heated to 50–60° and stirred for 24 hours. At the end of the reaction time, it was brought to a boil and the excess iodine was destroyed with solid sodium thiosulfate. On cooling, the solution was acidified and filtered. The residue was digested with boiling sodium hydroxide solution, filtered, and the filtrate was treated with charcoal. Upon filtration and acidification, the iodo-acid (IV) was obtained in a 0.5 g. (12%) yield as a white powder which when recrystallized from alcohol–water gave white needles, m.p. 223–224°.

A mixed melting point of the iodo-acid prepared in this manner and by the Sandmeyer reaction on diazotized tetrachloroanthranilic acid showed no depression.

A sealed-tube iodination of III (8 hr., 210–220°) gave approximately the same yields of IV.

Bromination of the Anhydro-2-hydroxymercuri-acid (III).—In a similar manner, 15.0 g. (0.033 mole) of III suspended in 250 ml. of water when treated with 6.8 g. (0.066 mole) of sodium bromide and 10.6 g. (0.066 mole) of bromine gave a 2.0 g. (18%) yield of the bromo-acid. Recrystallization from alcohol–water gave white needles, m.p. 222–223°.

A mixed melting point of the bromo-acid prepared in this manner and by the Sandmeyer reaction on diazotized tetrachloroanthranilic acid showed no depression.

A sealed-tube bromination of III (8 hr., 210–220°) gave lower yields of IV.

Methyl 2-Iodo-3,4,5,6-tetrachlorobenzoate (V).—The iodo-acid (IV) was quantitatively converted to the methyl ester (V) by adding the solid acid to an ethereal solution of diazomethane. After evaporation of the ether on a steam-bath, the crude product was recrystallized from alcohol to yield white fluffy needles, m.p. 103–103.5°.

Anal. Calcd. for $C_8H_3O_2Cl_4I$: C, 24.03; H, 0.76. Found: C, 24.36; H, 0.95.

Methyl 2-Bromo-3,4,5,6-tetrachlorobenzoate.—The bromo-ester was prepared from the bromo-acid in the same manner as the iodo-ester (V). The white needles melted at 111–112°.

Anal. Calcd. for $C_8H_3O_2Cl_4Br$: C, 27.23; H, 0.85. Found: C, 27.00; H, 0.97.

3,3′,4,4′,5,5′,6,6′-Octachloro-2,2′-dicarboxybiphenyl (VI).[12]—To 15.0 g. (0.0375 mole) of molten iodo-ester (V) maintained at 240–260° in a silicone oil-bath, was added, in small portions and with constant stirring, 15.0 g. (0.24 mole) of Baker precipitated copper. At the end of the addition, the reaction mass was heated to 290° for one-half hour. On cooling, the solid mass was thoroughly extracted with hot alcohol and filtered. The alcohol was removed by distillation and the dark brown residue was taken up in 30 ml. of 100% sulfuric acid, according to Newman's[13] rigorous procedure. After remaining overnight at room temperature, the acidic solution was poured into 500 ml. of ice-water and neutralized with solid sodium carbonate. Any insoluble tar was filtered, and the filtrate was treated with charcoal, reacidified and filtered. The light brown powder was then extracted with 150 ml. of boiling benzene to remove unreacted iodo-acid (IV) and the benzene-insoluble portion redissolved in alkali solution, treated with charcoal, filtered and reacidified. After several such treatments, the perchlorinated 2,2′-diphenic acid (VI) was obtained in a 2.9 g. (15%) yield as a tan powder which melts with decomposition to a brown viscous liquid, 265–275°.

Anal. Calcd. for $C_{14}H_2O_4Cl_8$: C, 32.47; H, 0.39; neut. equiv., 258.9. Found: C, 32.70; H, 0.80; neut. equiv., 258.7.

3,3′,4,4′,5,5′,6,6′-Octachloro-2,2′-dicarbomethoxybiphenyl (VII).—The dimethyl ester (VII) was obtained quantitatively from the dicarboxylic acid (VI) *via* the diazomethane technique. Recrystallization from alcohol–water gave white fluffy needles, m.p. 152–152.5°.

Anal. Calcd. for $C_{16}H_6O_4Cl_8$: C, 35.20; H, 1.11; Cl, 51.95. Found: C, 34.95; H, 1.26; Cl, 51.80.

ORGANIC PROCESS LABORATORY
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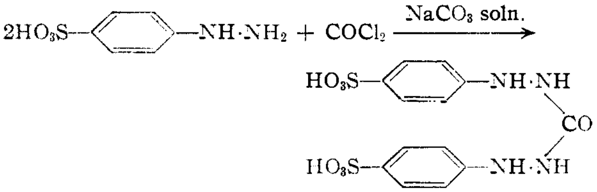
RECEIVED JUNE 15, 1951

Synthesis of 1,5-Bis-(1-phenyl-4-sulfonic Acid) Carbohydrazide (Sodium Salt)[1]

BY JAMES S. PARSONS[2] AND JOHN H. YOE

1,5-Bis-(1-phenyl-4-sulfonic acid)-carbohydrazide (sodium salt) has been recently recommended[3] as a good indicator in the mercurimetric determination of chloride. At the end-point the indicator gives a water-soluble deep violet complex with mercuric ions.

The indicator was synthesized by condensing phenylhydrazine *p*-sulfonic acid with phosgene in sodium carbonate solution as indicated



Bucherer and Schmidt[4] employed this type of reaction to prepare 1,5-bis-(1-naphthyl-4-sulfonic acid) carbohydrazide. The product was easily isolated as the sodium salt. We were unable to obtain 1,5-bis-(1-phenyl-4-sulfonic acid) carbohydrazide in a pure form by crystallization. However, using a simple chromatographic adsorption separation a product of satisfactory purity was easily obtained. The sodium and barium salts were prepared; both are highly soluble in water.

Experimental

Dissolve 0.3 mole of phenylhydrazine-*p*-sulfonic acid (sodium salt) and 15 g. of sodium carbonate in 400 ml. of distilled water. Transfer to a gas saturation apparatus provided with a fine fritted glass tube so that efficient saturation is obtained. Heat the solution to 50° and lead phosgene in slowly for 3 to 4 hours. The reaction mixture usually becomes acid in this time. Adjust the solution to about *p*H 1 with hydrochloric acid; filter off and discard any precipitate that forms. Pour the mixture through a column (diameter 3 cm., length 75 cm.) which has been carefully packed with about 200 g. of adsorption grade alumina (80–200 mesh). The column should be prewashed with water and then with 0.5 *N* hydrochloric acid. Care should be taken to avoid sucking air through the column and to prevent air bubbles lodging at the top surface of the alumina. Using either suction or air pressure the reaction mixture is allowed to flow through the column at about 5 ml. per minute. The 1,5-bis-(1-phenyl-4-sulfonic acid) carbohydrazide is adsorbed, giving a colorless band. A narrow brown band may be seen at the top of the column if any carbazone is present. Follow by pouring through distilled water until the filtrate gives a negative test for chloride or shows a leveling off of chloride traces. The water tends to develop or to spread the band which becomes slightly yellowish, apparently due to a slight oxidation of carbazide to carbazone. The distilled water is followed by pouring through 0.25 *M* sodium hydroxide. After a few minutes the top of the column begins to turn red and the band below turns darker

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(12) A direct synthesis of this symmetrical biaryl from the amino-acid,[4] using the procedures of Atkinson and co-workers, THIS JOURNAL, **62**, 1704 (1940); **63**, 730 (1941); **65**, 476 (1943), was unsuccessful. Our diazotization step occurred only in a large volume of a concentrated acid medium, whereas Atkinson's reductive coupling procedures invariably required ammoniacal solutions of the reducing agents. When a solution of cuprous chloride in concentrated hydrochloric acid was used as the coupling agent, no biaryl was isolated, as was expected from Atkinson's work.

(13) Newman, *ibid.*, **63**, 2431 (1941).

(1) From the Ph.D. dissertation of James S. Parsons, University of Virginia, 1950.

(2) American Cyanamid Company, Bound Brook, New Jersey.

(3) J. S. Parsons and J. H. Yoe, *Anal. Chim. Acta*, in press.

(4) H. T. Bucherer and M. Schmidt, *J. prakt. Chem.*, **79**, 408 (1909).

yellow. Both bands migrate down the column and eventually into the receiver. The first 200–300 ml. of the solution coming through the bottom of the column is clear and contains very little of the carbohydrazide. The next 400 ml. is yellowish-orange having a *p*H of 4–7 and contains the sodium salt of 1,5-bis-(1-phenyl-4-sulfonic acid) carbohydrazide. Finally, a red solution which contains small amounts of the alkaline form of the carbohydrazide and excess sodium hydroxide comes through the column. This red solution may be discarded. The 400 ml. of yellowish-orange solution is concentrated under reduced pressure at 40–50° with nitrogen being slowly bubbled through to minimize oxidation. The product is precipitated with 95% ethanol, filtered, redissolved in a small volume of water, reprecipitated with alcohol, vacuum dried at room temperature and stored in a desiccator over a solution of calcium chloride at 30% relative humidity. A sample was dried to constant weight at 105–110° and analyzed for sodium by the uranyl zinc acetate method.

Anal. Calcd. for $(NaSO_3 \cdot C_6H_4 \cdot NH \cdot NH)_2C{=}O$: Na, 10.33. Found: Na, 10.13. Loss in weight at 105–110°, 10.86%; loss corresponding to 3 moles of water.

1,5-Bis-(phenyl-4-sulfonic acid) carbohydrazide was also isolated as the barium salt by using 0.13 *M* barium hydroxide for eluting the sulfonic acid from the column. Analysis of this product for barium by the gravimetric barium sulfate method and for water of hydration by drying to constant weight gave results as follows.

Anal. Calcd. for $Ba(SO_3 \cdot C_6H_4 \cdot NH \cdot NH)_2C{=}O$: Ba, 25.54. Found: Ba, 25.47, 25.43. The loss in weight at 105–110° was 8.73%, corresponding to 2.9 moles of water for the above formula.

Yields of the purified material were 10–20% but no attempt was made to establish the maximum yield.

Acknowledgment.—We desire to express our thanks for funds supplied by the John Lee Pratt Trace Analysis Laboratory in partial support of this investigation.

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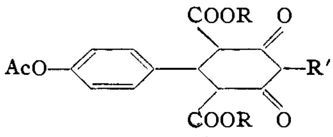
Synthesis of 1-(*p*-Acetoxyphenyl)-2,6-dicarbethoxy-4-methylcyclohexanedione-3,5. III

BY PHILIPPOS E. PAPADAKIS AND JOSEPH SCIGLIANO

In a previous communication[1] the synthesis of 1-(*p*-acetoxyphenyl)-2,6-dicarbethoxycyclohexanedione-3,5 (I) was reported. The object of the work presented here was the synthesis of a monomethyl derivative at carbon-4 of the cyclohexanedione ring (II). Since the direct methylation of I may result in isomeric monomethyl derivatives the following method was adopted which is assumed to give the desired product.

The sequence of the syntheses involved in this work is: *p*-acetoxybenzaldehyde → ethyl 4-acetoxybenzalmalonate→1(*p*-acetoxyphenyl)-2,6-dicarbethoxy-4-methylcyclohexanedione-3,5 (II). The synthesis of II was accomplished by condensing and cyclizing the sodio derivative of ethyl β-oxopentanoate with ethyl 4-acetoxybenzalmalonate. Substance (II) will serve not only as reference compound in experiments involving direct methylation of (I) but also as an intermediate in the further synthesis of substances related to steroids and other physiologically important compounds.



I, R′ = H
II, R′ = CH_3

Experimental

Reagents.—Ethyl β-oxopentanoate[2] was prepared by Grignard reaction of ethylmagnesium iodide on ethyl cyanoacetate. Ethyl 4-acetoxy-benzalmalonate[3] was prepared from *p*-acetoxybenzaldehyde and diethyl malonate using diethylamine as condensing agent.

1-(*p*-Acetoxyphenyl)-2,6-dicarbethoxy-4-methylcyclohexanedione-3,5 (II).—Ethyl 4-acetoxybenzalmalonate (5.88 g.) was treated with a mixture of equivalent quantities of ethyl β-oxopentanoate (2.8 g.) and CH_3ONa in absolute methyl alcohol. The mixture was refluxed on a water-bath for five hours, the alcohol evaporated and the residue dried for two hours under vacuum (oil-bath temperature 130°).

Upon cooling the solution was acidified with cold 3 *N* HCl, and then 5 cc. in excess. The precipitate was filtered off, washed several times with distilled water and dried in a vacuum desiccator. The dry crystals were washed with ether several times, m.p. 157°. When the crystals are dissolved with absolute ethyl alcohol, the solution gives a yellow ferric chloride test. (The material which dissolved in ether gives a red purple color with $FeCl_3$.)

Anal. Calcd. for $C_{21}H_{24}O_8$: C, 62.37; H, 5.98. Found: C, 62.80; H, 6.19.

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[1] Papadakis, THIS JOURNAL, **67**, 1799 (1945).

[2] Blaise, *Compt. rend.*, **132**, 970 (1901).

[3] Knoevenagel and Albert, *Ber.*, **37**, 4481 (1904).

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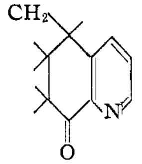
RECEIVED MAY 31, 1951

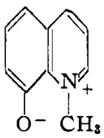
The Reaction of Diazomethane with 8-Quinolinols

BY J. P. PHILLIPS AND ROBERT W. KEOWN

The action of diazomethane on 8-quinolinol gives, in addition to 8-methoxyquinoline, a red, ether-insoluble solid originally thought to have structure I.[1] Apparently without further experimentation Schenkel-Rudin[2] pointed out that structure II, corresponding to nitrogen methylation of 8-quinolinol, was more in accord with the polar properties of the compound. (For convenience this compound will be called diazoxine hereafter.) The following new experimental facts support the Schenkel-Rudin structure.



I



II

5,7-Dibromo-8-quinolinol reacts with diazomethane to give a product showing a similar absorption spectrum (with a bathochromic shift due to the weighting effect of bromine) to that of diazoxine (Fig. 1). Diazoxine is quantitatively dibrominated to give a substance spectrophotometrically identical to the diazomethane-5,7-dibromo-8-quinolinol product.

Determination of the absorption spectrum of diazoxine in solutions of *p*H 1–13 shows only two different structures, a nearly colorless hydrochloride (which was isolated and analyzed) having absorption maxima at 313, 323 and 365 mμ, and an orange

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[1] Caronna and Sansone, *Gazz. chim. ital.*, **69**, 24 (1939).

[2] Schenkel-Rudin, *Helv. Chim. Acta*, **27**, 1456 (1944).