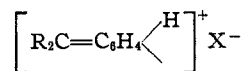


halochromizing agent, but that here, also, cleavage of the thio compound ensues first and is followed by the formation of the colored derivatives  $R_3C \cdot X$  ( $X = ClZnCl_2$ , or  $ClO_4$ ). Because of the naphthyl group in the molecule, these salts gradually undergo further change into colorless fluorene derivatives. It is now inferred that Wallis' conclusions concerning the nature of the halochromic derivatives were based on experimental evidence misleading in nature. When reinterpreted in the light of the evidence presented in this paper, his results do not preclude for the halochromic compounds a quinonoid structure, these results being equally consistent with that or with the carbonium-ion constitution of these derivatives. Both structures predicate carbinol formation on hydrolysis, and racemization, in the process: colorless triarylcarbinol derivative  $\longrightarrow$  halochromization  $\longrightarrow$  carbinol.

4. The advantages, however, of the quinonoid hypothesis concerning the constitution for the substances under discussion are becoming generally recognized and with various slight modifications that constitution is being accepted.<sup>18</sup> The constitution as originally proposed,<sup>19</sup> namely, the *quinocarbonium salt* structure



takes account of both concomitant phenomena, the salt-character and the chromogenic character of the compounds, and is capable of accounting for their many strictly chemical properties which would remain otherwise unexplainable.

(18) Hantzsch and Burwoay, *Ber.*, **64**, 1622 (1931); Burwoay, *ibid.*, 1635; Lifschitz, *Zeits. wissents. Photogr., Photochem. u. Photochem.*, **32**, 131 (1932).

(19) Gomberg, *Ber.*, **40**, 1847 (1907); **42**, 406 (1909); *Ann.*, **370**, 142 (1909); **376**, 183 (1910).

ANN ARBOR, MICHIGAN

RECEIVED AUGUST 21, 1934

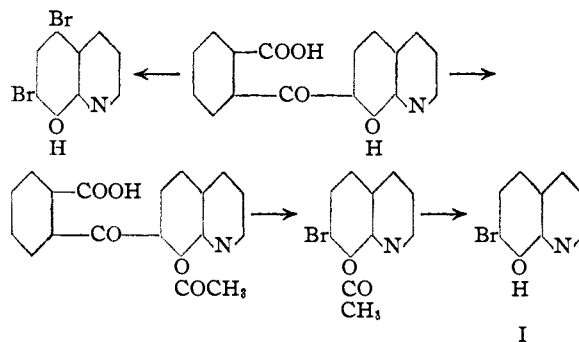
[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF KITASATO INSTITUTE]

## Friedel and Crafts Reaction with 8-Hydroxyquinoline

BY KONOMU MATSUMURA

8-Hydroxyquinoline reacts with propionyl chloride to give 5-propionyl-8-hydroxyquinoline, the oxime of which on Beckmann change followed by hydrolysis yields 8-hydroxyquinoline-5-carboxylic acid.

The interaction of one mole each of 8-hydroxyquinoline and phthalyl chloride was found to result in 7-*o*-carboxylic-benzoyl-8-hydroxyquinoline (I) predominantly (as a by-product, the formation of  $\alpha$ -8,8'-dihydroxydiquinolyl phthalide could be ascertained), which on distillation broke up into 8-hydroxyquinoline and phthalic anhydride, contrary to the expectation of decarboxylation. Upon treatment with one mole of bromine, it gave a monobromo derivative, while with two moles of bromine, it gave 5,7-dibromo-8-hydroxyquinoline, undergoing customary fission at the place of carbonyl linkage. On the other hand, the acetyl derivative on bromination and subsequent hydrolysis afforded 7-bromo-8-hydroxyquinoline, thus establishing the structure of this compound (I), but under no circumstances could oximation be effected, this being a customary difficulty in a  $\gamma$ -ketonic acid.



Furthermore, this compound could not be converted into the corresponding anthraquinone-quinoline derivative by the action of concd. sulfuric acid at 180° for two hours. This appears to provide an additional evidence in support of the view that the phthalic acid group is attached to the quinoline molecule at the 7 position and not at the 5 position of the latter.

The reaction of two moles of 8-hydroxyquinoline and one mole of phthalyl chloride was found to give a compound whose molecular composition and chemical behavior corresponded to 8,8'-dihydroxydiquinolylphthalide.

Upon treatment with sodium amalgam, it was converted into *o*-carboxylic-phenyl-8,8'-dihydroxydiquinolylmethane which, when heated at 350° with the object of splitting off carbon dioxide, regenerated the initial phthalide.

This compound could not be made to undergo ring closure by the action of either concd. sulfuric acid or zinc chloride, whereas fuming sulfuric acid (10%) reacted with this compound to give a sulfonic acid derivative of the phthalide. In one

no definite evidence could be obtained in both phthalides, and in connection with this problem, it would be pointed out that there are three possible phthalide structures, two symmetrical and one unsymmetrical.

### Experimental

A solution of 8-hydroxyquinoline (26.1 g.), acid chlorides and aluminum chloride (60 g.) in nitrobenzene (240 g.) was heated in an oil-bath. On cooling, some ice and dilute hydrochloric acid (10%, 60 cc.) was added, nitrobenzene

TABLE I  
FRIEDEL-CRAFTS REACTION

No.	Reactant	G.	Temp., °C.	Reaction Time, hrs.	Product	Yield, g.
1	Propionyl chloride	18.3	70-80	6	5-Propionyl-8-hydroxyquinoline	5
2	Phthalyl chloride <sup>a</sup>	57	100-110	7	7- <i>o</i> -Carboxylic-benzoyl-8-hydroxyquinoline	43
3	Phthalyl chloride	18.3	70-110	18	$\alpha$ -8,8'-Dihydroxy-diquinolylphthalide	31.5

No.	Compound	Properties	Color reaction with FeCl <sub>3</sub>	M. p., °C.
1	5-Propionyl-8-hydroxyquinoline	Colorless needles from ether.	Sol. in hot water	91
2	7- <i>o</i> -Carboxylicbenzoyl-8-hydroxyquinoline	Light yellow needles from NO <sub>2</sub> -C <sub>6</sub> H <sub>5</sub> or alc.		226
3	$\alpha$ -8,8'-Dihydroxydiquinolylphthalide <sup>b</sup>	Easily sol. in Na <sub>2</sub> CO <sub>3</sub>	Green	>360
4	$\beta$ -8,8'-Dihydroxydiquinolylphthalide <sup>c</sup>	Light yellow prisms from NO <sub>2</sub> -C <sub>6</sub> H <sub>5</sub>	Dark brown	292
		Colorless plates from alc.	Green	

No.	Formula	Carbon, %		Hydrogen, %		Nitrogen, %	
		Calcd.	Found	Calcd.	Found	Calcd.	Found
1	C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N	71.64	71.86	5.47	5.28	6.97	7.09
2	C <sub>17</sub> H <sub>11</sub> O <sub>4</sub> N	69.62	69.55	3.75	4.00	4.78	4.76
3	C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub>	74.29	74.27	3.81	3.86	6.67	6.90
4	C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub>	74.29	74.54	3.81	3.85	6.67	6.88

<sup>a</sup> Employment of one mole each of the components was found to give (I) together with a small amount of the  $\alpha$ -phthalide and hence to avoid the formation of the by-product, the employment of phthalyl chloride in excess was found to be advisable.

<sup>b</sup> Fairly soluble in nitrobenzene and chloroform, difficultly in ethyl acetate, alcohol and benzene but insoluble in ether. Difficultly soluble in warm sodium carbonate and easily soluble in dilute sodium hydroxide with deep green color which disappeared on standing or on heating.

<sup>c</sup> The solution in sodium hydroxide or carbonate exhibits an intense indigo-blue color.

preparation only but not successfully repeated there was isolated another product which would appear to have also a structure of 8-8'-dihydroxydiquinolylphthalide, from the filtrate in the preparation of the phthalide described above.

The former phthalide is now called the  $\alpha$ -form and the latter the  $\beta$ -form.

The  $\beta$ -phthalide dissolves in alkali with a deep indigo-blue color, in this respect differing markedly from the  $\alpha$ -form which exhibits a green color in alkaline solution.

The  $\beta$ -isomeride by the action of concd. sulfuric acid afforded a red crystalline material C<sub>17</sub>H<sub>9</sub>O<sub>4</sub>N which is free from sulfur, soluble in dilute sodium bicarbonate and is neither a fluorane nor anthraquinonequinoline derivative.

With respect to the positions of attachment of the two quinoline rings to the phthalic acid group,

TABLE II

DERIVATIVES OF 5-PROPIONYL-8-HYDROXYQUINOLINE			
Derivative	M. p., °C.	Properties	
Hydrochloride	279-280 (dec.)	Yellow columns from dil. HCl. Hydrolyzes in water	
Picrate	192	Yellow needles from water	
Chloroplatinate	227-228 (dec.)	Orange-yellow needles from dil. HCl	
Methyl iodide	196-197	Brown-yellow needles from methanol	
Oxime	144-145	Colorless prisms from alc.	
Acid sulfate	230-231	Colorless prisms from alc.	
		Easily sol. in water	

Formula		Analyses, %	
		Calcd.	Found
C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N·HCl	HCl	15.37	15.03
C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N·C <sub>8</sub> H <sub>3</sub> O <sub>7</sub> N <sub>3</sub>	N	13.02	12.85
(C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N) <sub>2</sub> ·H <sub>2</sub> PtCl <sub>6</sub>	Pt	24.01	23.77
C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N·CH <sub>3</sub> I	I	37.03	36.76
C <sub>12</sub> H <sub>12</sub> O <sub>2</sub> N <sub>2</sub>	N	12.96	13.04
C <sub>12</sub> H <sub>11</sub> O <sub>2</sub> N·H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	32.78	32.65

TABLE III

DERIVATIVES OF 7-*o*-CARBOXYLIC-BENZOYL-8-HYDROXY-QUINOLINE

Derivative	M. p., °C.	Properties
Hydrochloride	244 (dec.)	Yellow prisms from dil. HCl. Hydrolyzes in water
Chloroplatinate	245 (dec.)	Orange-yellow plates from dil. HCl
Methyl ester <sup>a</sup>	143-144	Yellowish-white columns from alc.
Hydrochloride of methyl ester	252-252.5 (dec.)	Yellow prisms from alc. Hydrolyzes in water
Hydrazide <sup>b</sup>	326 (dec.)	Yellow prismatic needles from nitrobenzene
Diacetyl <sup>c</sup>	147-150	Colorless needles from dil. acetic acid
Benzoyl <sup>d</sup>	195	Colorless plates from alc.
5-Bromo- <sup>e</sup>	227-228 (dec.)	Orange-yellow prisms from alc.
5-Iodo <sup>f</sup>	224 (dec.)	Garnet-colored prisms from alc.

Formula		Analyses, %	
		Calcd.	Found
C <sub>17</sub> H <sub>11</sub> O <sub>4</sub> N·HCl	HCl	11.08	10.72
(C <sub>17</sub> H <sub>11</sub> O <sub>4</sub> N) <sub>2</sub> ·H <sub>2</sub> PtCl <sub>6</sub>	Pt	19.60	19.53
C <sub>18</sub> H <sub>13</sub> O <sub>4</sub> N	C	70.36	70.64
	H	4.23	4.42
	N	4.56	4.62
	—OCH <sub>3</sub>	10.10	9.64
C <sub>18</sub> H <sub>13</sub> O <sub>4</sub> N·HCl	HCl	10.63	10.26
C <sub>17</sub> H <sub>13</sub> O <sub>3</sub> N <sub>2</sub>	N	13.68	13.98
C <sub>21</sub> H <sub>15</sub> O <sub>6</sub> N	C	66.84	66.68
	H	3.98	4.62
	N	3.71	3.92
C <sub>24</sub> H <sub>19</sub> O <sub>6</sub> N	C	72.54	72.70
	H	3.78	4.05
	N	3.53	3.68
C <sub>17</sub> H <sub>10</sub> O <sub>4</sub> NBr	Br	21.49	21.84
C <sub>17</sub> H <sub>10</sub> O <sub>4</sub> NI	I	30.31	31.20

<sup>a</sup> Prepared by the methanol and hydrogen chloride method. <sup>b</sup> Obtained, in theoretical yield, by refluxing ester (4.75 g.) with hydrazine hydrate (1.5 g.) for ten hours on a water-bath. <sup>c</sup> This compound may be a mixed acid anhydride of acetic acid and the monoacetyl compound. <sup>d</sup> Made by pyridine method. <sup>e</sup> Prepared by means of sodium hypobromite. <sup>f</sup> Prepared by means of alcoholic solution of iodine in 0.2 N HCl as medium. This compound, in alkaline solution on warming, yielded 5,7-diiodo-8-hydroxyquinoline (m. p. 208-210°) which was identified by comparison with a known specimen (*Anal.* Calcd. for C<sub>9</sub>H<sub>5</sub>ONI<sub>2</sub>: I, 63.98. Found: I, 64.88). <sup>g</sup> Both compounds give an intense red color reaction with diazotized sulfanilic acid and alkali, perhaps by the displacement of halogen by azo group.

removed by steam distillation and evaporated when necessary to a small volume. The hydrochloride of the condensation product which separated on standing, was recrystallized from dilute hydrochloric acid.

The free base was isolated, by means of sodium acetate (1), by dissolving the hydrochloride in sodium carbonate and precipitating with acetic acid (2) or by dissolving the

hydrochloride in sodium hydroxide and precipitating with acetic acid (3), respectively.

TABLE IV

DERIVATIVES OF  $\alpha$ -8,8'-DIHYDROXYDIQUINOLYLPHTHALIDE

Derivative	Properties
Hydrochloride	Yellow columns from dil. HCl. Hydrolyzes in water
Chloroplatinate	Yellow prisms from dil. HCl
Diacetyl-	Colorless needles from acetic anhydride
Dibenzoyl-	Colorless prisms from ethyl acetate
Trisodium salt <sup>a</sup>	Yellow prismatic needles from NaOH (20%). Hydrolyzes in water
Monosodium salt <sup>b</sup>	Yellow needles from alc.
Dibromo- <sup>c</sup>	Yellowish-white prisms from nitrobenzene. Sol. in alkali with green color

M. p., °C.	Formula	Analyses, %		
		Calcd.	Found	
>353	C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub> ·HCl	HCl	8.00	8.33
>315	(C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub> ) <sub>2</sub> ·H <sub>2</sub> PtCl <sub>6</sub>	Pt	15.62	15.02
280-300 (dec.) without melting)	C <sub>30</sub> H <sub>20</sub> O <sub>6</sub> N <sub>2</sub>	C	71.43	71.30
		H	3.97	4.08
		N	5.56	5.77
325-331 (dec.)	C <sub>40</sub> H <sub>24</sub> O <sub>6</sub> N <sub>2</sub>	C	76.43	76.39
		H	3.82	3.80
		N	4.46	4.44
	C <sub>26</sub> H <sub>15</sub> O <sub>5</sub> N <sub>2</sub> Na <sub>3</sub>	Na	13.69	13.92
	C <sub>26</sub> H <sub>15</sub> O <sub>4</sub> N <sub>2</sub> Na	Na	5.20	6.03
>350	C <sub>26</sub> H <sub>14</sub> O <sub>4</sub> N <sub>2</sub> Br <sub>2</sub>	Br	27.66	27.38

<sup>a</sup> At 100° it became a brown powder with the loss of water of crystallization. <sup>b</sup> Obtained on recrystallization of the trisodium salt from hot alcohol. On being dried at 100°, it turned to deep green, perhaps with the formation of quinonoid structure with the elimination of one mole of water. <sup>c</sup> Bromination was carried out in 0.2 N HCl solution at 15°.

TABLE V

DERIVATIVES OF  $\beta$ -8,8'-DIHYDROXYDIQUINOLYLPHTHALIDE

Derivative	Properties
Hydrochloride	Yellow columns from dil. HCl. Hydrolyzes in water
Chloroplatinate	Yellow prisms from dil. HCl
Diacetyl-	Colorless prisms from acetic anhydride

M. p., °C.	Formula	Analyses, %		
		Calcd.	Found	
261	C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub> ·2HCl·7H <sub>2</sub> O	H <sub>2</sub> O	20.36	20.28
>320 (grey at 270°)	C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub> ·2HCl	HCl	14.81	14.07
277-279 (dec.)	(C <sub>26</sub> H <sub>16</sub> O <sub>4</sub> N <sub>2</sub> ) <sub>2</sub> ·H <sub>2</sub> PtCl <sub>6</sub>	Pt	15.62	16.30
		C	71.43	71.65
		H	3.97	4.06
	C <sub>30</sub> H <sub>20</sub> O <sub>6</sub> N <sub>2</sub>	N	5.56	5.75

**Beckmann Rearrangement of 5-Propionyl-8-hydroxyquinoline Oxime.**—The ether solution of the oxime (1 g.) was treated with thionyl chloride in a manner approximately similar to that described for the rearrangement of the oxime of 5-benzoyl-8-hydroxyquinoline;<sup>1</sup> yield, 0.8 g. It forms in colorless needles from alcohol, melting at 193-194°. Its mixed melting point with an authentic speci-

(1) Matsumura, *THIS JOURNAL*, **53**, 1494 (1931).

men of 5-propionylamino-8-hydroxyquinoline (m. p. 213–214°) gave 180–191°, suggesting that the product may be 8-hydroxyquinoline-5-carboxylic acid ethylamide.

*Anal.* Calcd. for  $C_{12}H_{12}O_2N_2$ : N, 12.96. Found: N, 12.80.

**8-Hydroxyquinoline-5-carboxylic Acid.**—A mixture of 0.2 g. of the compound above described and 10 g. of concd. hydrochloric acid was refluxed for ten hours. The product formed egg-yellow needles from alcohol melting at 273° alone or mixed with a known specimen.

**5-Propionylamino-8-hydroxyquinoline**, prepared by the interaction of 5-amino-8-hydroxyquinoline with propionic anhydride, gave colorless thin plates from benzene, m. p. 213–214°.

*Anal.* Calcd. for  $C_{12}H_{12}O_2N_2$ : N, 12.96. Found: N, 13.16.

**Distillation of 7-*o*-Carboxylic-benzoyl-8-hydroxyquinoline.**—On heating the compound (1 g.) in an oil-bath (300°), a yellow oil which soon turned to a crystalline solid (0.8 g.) distilled over. It was digested with dilute sodium carbonate. The undissolved matter (0.4 g.) formed colorless needles from ether, melting at 74° alone or mixed with a specimen of 8-hydroxyquinoline.

The alkaline solution, on acidification, afforded yellowish-white needles (0.2 g.), m. p. 186–187° (dec.), which after two distillations gave a product of m. p. 130–131°. It was identified as phthalic anhydride by the mixed melting point method.

**Bromination of 7-*o*-Carboxylic-benzoyl-8-hydroxyquinoline with Two Moles of Bromine.**—Bromine (1.5 g.) was dropped in portions at intervals into a solution of 7-*o*-carboxylic-benzoyl-8-hydroxyquinoline (1 g.) in dilute hydrochloric acid (0.2 *N*, 500 cc.) with vigorous stirring at room temperature (20°). The product formed colorless columns from benzene, melting at 197°. The mixed melting point with an authentic specimen of 5,7-dibromo-8-hydroxyquinoline (m. p. 197–198°) prepared by brominating 8-hydroxyquinoline after the method of Claus<sup>2</sup> showed no depression.

*Anal.* Calcd. for  $C_9H_5ONBr_2$ : Br, 52.78. Found: Br, 52.16.

**7-Bromo-8-hydroxyquinoline.**—A solution of bromine (0.5 g.) in glacial acetic acid (6 cc.) was dropped into the solution of diacetyl-7-*o*-carboxylic-benzoyl-8-hydroxyquinoline (1.2 g.) in glacial acetic acid (75 cc.) with stirring at 16° during one-half hour. After standing for four hours and pouring into cold water which contained some sodium acetate, a crystalline solid separated. It was refluxed with alcoholic potash for several minutes. On addition of water and treatment with carbon dioxide gas, a colorless solid separated (0.5 g.).

It afforded colorless prisms from alcohol, m. p. 138–139° which coincided with that of 7-bromo-8-hydroxyquinoline given by Claus.<sup>3</sup> The mixed melting point with an authentic specimen of 5-bromo-8-hydroxyquinoline (m. p. 128–129°, colorless long needles), prepared by the method of Claus and completely purified through its hydrochloride, gave 105–118°. Claus and Howitz found m. p. 124° for their product.

(2) Claus and Howitz, *J. prakt. Chem.*, [2] **44**, 444 (1886).

(3) Claus and Givartovsky, *ibid.*, [2] **54**, 379 (1896).

*Anal.* Calcd. for  $C_9H_5ONBr$ : Br, 35.71. Found: Br, 35.48.

**$\alpha$ -8,8'-Dihydroxydiquinolyphthalide Sulfonic Acid.**—A solution of  $\alpha$ -diquinolyphthalide (1 g.) in ten times its weight of fuming sulfuric acid (10%) was heated at 160° for three hours.

The yellow solid, which separated on being poured into ice water, was dissolved in dilute sodium carbonate, and again precipitated with acetic acid. On being warmed on a water-bath, the precipitates soon turned to yellow needles. On being dried at 100°, it acquired a red color with the loss of water of crystallization, m. p. >350°. It is sparingly soluble in the usual organic solvents and in dilute mineral acid but easily soluble in dilute sodium carbonate with deep green color. The alcoholic solution gives dark brown color with ferric chloride.

*Anal.* (water of crystallization) Calcd. for  $C_{26}H_{16}O_7N_2S \cdot 4.5H_2O$ :  $H_2O$ , 13.94. Found:  $H_2O$ , 14.65. Calcd. for  $C_{26}H_{16}O_7N_2S$ : C, 62.40; H, 3.20; S, 6.40. Found: C, 62.19; H, 3.52; S, 5.43.

**$C_{17}H_9O_4N$ .**—A solution of  $\beta$ -8,8'-dihydroxydiquinolyphthalide (2 g.) in concd. sulfuric acid (20 g.) was heated at 170–180° for three hours and then poured into ice water. Excess of sulfuric acid was removed by means of barium carbonate. The filtrate, on alkalification, filtration and subsequent addition of acetic acid, gave a red gelatinous precipitate (0.5 g.) which forms red needles from nitrobenzene, m. p. >340°. It is almost insoluble in alcohol, difficultly in dilute mineral acids but easily soluble in dilute sodium carbonate or warm sodium bicarbonate with orange-red color. The solution in concd. sulfuric acid assumes red color.

*Anal.* Calcd. for  $C_{17}H_9O_4N$ : C, 70.10; H, 3.09; N, 4.81. Found: C, 70.33, 69.96; H, 3.35, 3.39; N, 4.81, 4.89.

***o*-Carboxylic-phenyl- $\alpha$ -8,8'-dihydroxydiquinoly-methane.**—A solution of the  $\alpha$ -8,8'-dihydroxydiquinolyphthalide (1 g.) and sodium hydroxide (0.5 g.) in water (50 cc.) was treated with sodium amalgam (4%, 3 g.) at 0° for one and one-half hours with constant stirring until the green color disappeared completely. On addition of dilute acetic acid, yellowish solids, which turned to needles on warming for several minutes on a water-bath, separated, yield 0.95 g. It formed yellow prisms from ethyl acetate of m. p. 352° (dec.). It is easily soluble in dilute sodium carbonate with light yellow color and fairly soluble in alcohol and benzene.

*Anal.* Calcd. for  $C_{26}H_{18}O_4N_2$ : C, 73.93; H, 4.27; N, 6.64. Found: C, 73.86; H, 4.35; N, 6.47

On heating this substance in a test-tube at 350° for one-half hour, it gave the  $\alpha$ -8,8'-dihydroxydiquinolyphthalide in 75% yield.

The attempted reduction of the phthalide with zinc dust and alkali in the usual manner failed.

The methyl ester was prepared by the methanol and hydrogen chloride method in the cold. It formed light yellow needles from alcohol, m. p. 330° (dec.).

*Anal.* Calcd. for  $C_{27}H_{20}O_4N_2$ : C, 74.31; H, 4.59; N, 6.42. Found: C, 74.02; H, 4.68; N, 6.63.

The triacetyl derivative gave colorless prismatic needles from ethyl acetate, m. p. 288–291° (dec.). The analytical

figures indicated that this compound was a mixed acid anhydride.

*Anal.* Calcd. for  $C_{32}H_{24}O_7N_2$ : C, 70.07; H, 4.38; N, 5.11. Found: C, 70.25; H, 4.35; N, 5.23.

I hereby desire to thank Professor Hata for his interest in the work.

### Summary

The preparation of 5-propionyl- and 7-*o*-carboxylic-benzoyl-8-hydroxyquinoline and 8,8'-dihydroxydiquinolylphthalide has been reported.

TOKYO, JAPAN

RECEIVED SEPTEMBER 4, 1934

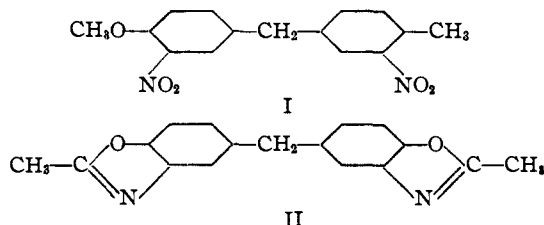
[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF KITASATO INSTITUTE]

## Nitration of 4,4'-Dimethoxydiphenylmethane

BY KONOMU MATSUMURA

It was a matter of interest to know whether nitro groups enter the 5,5' or 6,6' positions of 4,4'-dimethoxydiphenylmethane on di-nitration, because of *p*-methoxybenzyl and methoxyl groups both are *o-p*-directors. Moreover, the 6,6'-dinitro derivative might provide a convenient material for the preparation of 3,6-dimethoxy-acridone which in turn is an intermediate for acridine compounds of therapeutic importance.<sup>1</sup>

Upon nitration of 4,4'-dimethoxydiphenylmethane with fuming nitric acid, however, the product was found to be 5,5'-dinitro-4,4'-dimethoxydiphenylmethane (I).



The 4,4'-dihydroxydinitrodiphenylmethane of Staedel in which the positions of the dinitro groups have not been established,<sup>2</sup> on methylation gave 4,4'-dimethoxydinitrodiphenylmethane which was found to be identical with that (I) obtained by dinitration of 4,4'-dimethoxydiphenylmethane, and, on the other hand, the 4,4'-dihydroxydinitrodiphenylmethane of Staedel on reduction followed by acetylation and subsequent distillation afforded a dioxazole derivative (II).

This established the orientation of both the nitro groups as being in the ortho positions to the methoxyl as well as to the hydroxyl groups.

### Experimental

**4,4'-Dimethoxydiphenylmethane.**—The following modification of Ter Meer's method was found to be the best.<sup>3</sup>

- (1) Matsumura, *THIS JOURNAL*, **51**, 816 (1929).
- (2) Staedel, *Ann.*, **283**, 163 (1894).
- (3) Ter Meer, *Ber.*, **7**, 1200 (1874).

To the cooled solution (8°) of methylal (35.5 g.) and anisole (110 g.) in glacial acetic acid (110 g.) was added a cooled solution of concd. sulfuric acid (17 g.) in glacial acetic acid (135 g.). The resulting homogeneous solution, after standing for twenty-four hours at 8°, was poured into ice water (3 liters). The separated oil was fractionated in a Claisen flask. The portion (102 g.) which distilled at 320–340° (*ca.* 80% being distilled at 338°, 762 mm.) and solidified at room temperature (30°) was taken. Upon pressing on a porous plate, 85 g. of colorless crystals, m. p. 51–52°, was obtained.<sup>4</sup>

**Nitration of 4,4'-Dimethoxydiphenylmethane.**—Fuming nitric acid (12 g.) was gradually added to the cooled solution (10°) of 4,4'-dimethoxydiphenylmethane (5 g.) in glacial acetic acid (10 g.) with stirring at a temperature not exceeding 30°. The product, after pouring into ice water, formed yellowish white plates from alcohol, m. p. 164.5–165.5°; yield, 1.7 g. The alcoholic mother liquor, on evaporation, gave a yellow oil (4.6 g.) from which, on oxidation with chromic acid, no definite product could be isolated. It is soluble in glacial acetic acid and alcohol but difficultly in ether.

*Anal.* Calcd. for  $C_{15}H_{14}O_6N_2$ : C, 56.60; H, 4.40; N, 8.81. Found: C, 56.85; H, 4.19; N, 8.88.

**5,5'-Dinitro-4,4'-dimethoxybenzophenone.**—Chromic oxide (3 g.) was added to the hot solution of 5,5'-dinitro-4,4'-dimethoxydiphenylmethane (1.5 g.) in glacial acetic acid (30 g.) and the solution refluxed for four hours. The product gave almost colorless flat needles from dilute acetic acid (60%), m. p. 193°; yield, 1.25 g. It is soluble in alcohol and benzene but almost insoluble in ether.

*Anal.* Calcd. for  $C_{11}H_{12}O_7N_2$ : C, 54.22; H, 3.61; N, 8.43. Found: C, 54.41; H, 3.60; N, 8.41.

**Methylation of Dinitro-4,4'-dihydroxydiphenylmethane.**—A mixture of powdered disodium salt prepared from 1.45 g. of Staedel's dinitrodihydroxydiphenylmethane, dimethyl sulfate (2 cc.) and toluene (1 cc.) was refluxed for one hour. The product formed bundles of yellow needles from alcohol, m. p. 163–164°; yield, 1.2 g. The mixed melting point with the specimen obtained by nitration of 4,4'-dimethoxydiphenylmethane showed no depression.

*Anal.* Calcd. for  $C_{15}H_{14}O_6N_2$ : N, 8.81. Found: N, 8.94.

- (4) Beck gives m. p. 48–49°, b. p. 330–340° and Ter Meer gives m. p. 52°, b. p. >360° for their products [*Beck, Ann.*, **194**, 323 (1878), and *Ter Meer, Ref. 3*].