

1-Diethylaminobutane-3.<sup>14</sup>—In a 500-cc. flask fitted with a reflux condenser was placed 43 g. of formalin solution, 54.7 g. of diethylamine hydrochloride and 145 g. of acetone. The mixture was refluxed for twelve hours and the acetone and some water removed by distillation. The residue was treated with potassium carbonate solution and extracted with ether. The ether extract was dried over potassium carbonate and then fractionated. The amino ketone boiled at 84° (30 mm.) and 53° (4 mm.); yield, 31 g. or 42%.

*Anal.* Calcd. for C<sub>8</sub>H<sub>17</sub>ON: N, 9.79. Found: N, 9.80.

Treatment of this amino ketone with sodium hypoiodite yielded yellow crystals of iodoform melting at 118–119°.

### Summary

1. Ethyl 1-methyl-2-pyrrolidineacetate has been synthesized by the catalytic reduction of the ethyl 1-methyl-2-pyrrolacetate which was prepared from 1-methylpyrrole and ethyl diazoacetate.

2. This synthetic ester was identical with ethyl homohygrinate obtained as a degradation product of cuscohygrine by the action of nitric oxide and sodium ethylate.

3. Cuscohygrine did not react with benzaldehyde and failed to give an iodoform test.

4. These data together with previous investigations indicate that cuscohygrine is probably a *sym-bis*-(1-methylpyrrolidyl)-acetone.

(14) Mannich, *Arch. Pharm.*, **255**, 261 (1917).

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CINCINNATI]

## Synthesis and Resolution of Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-aminomethane

BY FRANCIS EARL RAY AND WILLIAM A. MOOMAW

In a previous paper<sup>1</sup> the authors described the effect of negative substituents in the benzene ring on the amines resulting from the condensation of aromatic aldehydes with  $\beta$ -naphthol and ammonia. It was found that the presence of negative substituents decreased the stability of the amines.

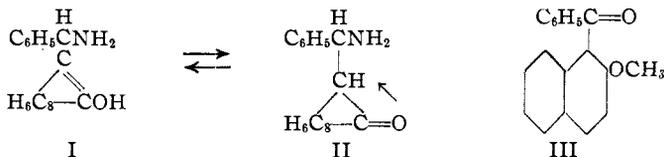
As it was thought that the tautomerism of the  $\beta$ -naphthol contributed to the instability of the amine we sought to replace the ionizable hydrogen with a methyl group.

When, however,  $\beta$ -methoxynaphthalene was mixed with benzaldehyde and ammonia no reaction took place. It was necessary, therefore, to use other means to synthesize the desired amine. Attempts to methylate or acetylate the hydroxy group, I, were unsuccessful as the amino group reacted first.<sup>2</sup> If the amino group was first blocked the hydroxyl group

(1) Ray and Moomaw, *THIS JOURNAL*, **55**, 749 (1933).

(2) Nzeer Ahmed, Master's Thesis, University of Cincinnati, 1933.

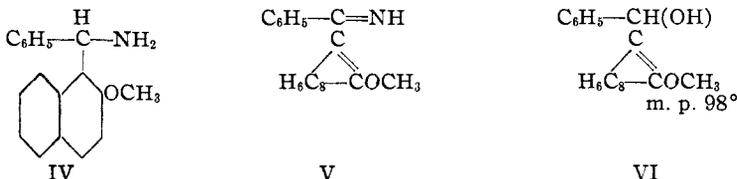
could be methylated or acetylated but it was then impossible to remove the amino acetyl group without decomposing the compound.



An attempt was made to prepare the desired amine by first making the ketone, III, by the Friedel-Crafts reaction, converting this into the oxime, and finally reducing the oxime to the amine, IV.

The ketone, III, was readily prepared but it did not react with hydroxylamine or phenylhydrazine. This is an extension of Meyer's rule<sup>3</sup> to the effect that when a carbonyl group is connected to an aromatic nucleus which contains two substituents ortho to it no oxime or hydrazone is formed. In view of the fact that the phenylhydrazone was prepared by indirect means it may also be possible to find conditions that will give the desired oxime. The problem of steric hindrance as applied to these compounds is being studied further in this Laboratory.

There was also the possibility that the methyl group might, under the influence of aluminum chloride, migrate from oxygen to a carbon of the nucleus, a somewhat general reaction of the phenol ethers.<sup>4</sup>



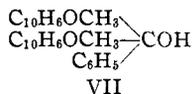
In order to determine if the compound from the Friedel-Crafts condensation had the structure III, we sought to prepare it by means of the Grignard reaction.  $\beta$ -Methoxynaphthyl-magnesium iodide was treated with benzonitrile. On hydrolysis with water and dilute acid a compound was obtained that contained iodine. When this compound was treated with alkali an iodine-free basic substance was obtained which was identified as phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-ketimine, V. Hot alkali or boiling acid hydrolyzed this to the ketone, III, identical with that prepared by the Friedel-Crafts reaction. Each was separately reduced to the identical alcohol,<sup>5</sup> VI, thus proving that no rearrangement had occurred in the reaction with aluminum chloride. The same alcohol was obtained by

(3) Meyer, *Ber.*, **29**, 830 (1896); compare the esterification rule of Meyer and Sudborough, *ibid.*, **27**, 510, 1580, 3146 (1894).

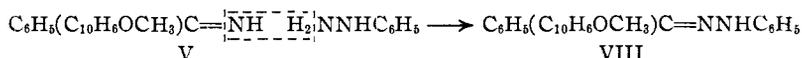
(4) Smith, *THIS JOURNAL*, **55**, 849 (1933).

(5) Bauer [*Ber.*, **42**, 2589 (1909)] has reported a melting point of  $237^\circ$  for this compound but gives no analytical data. This melting point is entirely out of line with that of similar compounds; diphenylcarbinol  $68^\circ$ ,  $\alpha$ -naphthylphenylcarbinol  $86^\circ$ , di- $\alpha$ -naphthylcarbinol  $147^\circ$ .

reaction of  $\beta$ -methoxynaphthyl- $\alpha$ -magnesium iodide with benzaldehyde. When the Grignard reagent was treated with methyl benzoate there was isolated in addition to the ketone, III, the tertiary alcohol, VII.



It is interesting to note that although the ketone gave no hydrazone the ketimine, V, readily reacted with phenylhydrazine to give the required phenylhydrazone, VIII.



Though we were unable to use the ketone in the preparation of the amine due to our inability to prepare the intermediate oxime, our objective was reached by reducing the ketimine, V, to the amine, IV, with sodium amalgam. This amine was resolved into its enantiomorphous forms by means of *l*-malic acid.

The new amine showed none of the tendency to decompose that had been noted for the amines with a free naphtholic group; the specific rotation was over three times as great; and the compound was more basic.

Phenyl- $\beta$ -naphtholaminomethane may be recrystallized from acetone but our amine reacts with acetone at ordinary temperatures giving a sparingly soluble Schiff base that is excellent for purposes of identification. Benzaldehyde also reacts with our amine to give a similar Schiff base.

### Experimental Part

**Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl) Ketone.**—This compound was prepared by condensing benzoyl chloride and  $\beta$ -methoxynaphthalene by means of aluminum chloride in carbon disulfide. After reacting, the mass was poured into water and steam distilled. The residue was recrystallized from alcohol; m. p. 125° corr.; yield 85%.

*Anal.* Calcd. for  $\text{C}_{18}\text{H}_{14}\text{O}_2$ : C, 82.44; H, 5.34. Found: C, 82.6; H, 5.4. *Mol. wt.* (Rast method) Calcd.: 262. Found: 270.

$\alpha$ -Iodo- $\beta$ -naphthol, m. p. 94°, was prepared in 72% yields according to the method of Mendola.<sup>6</sup>

$\alpha$ -Iodo- $\beta$ -methoxynaphthalene.—This was obtained from the above-mentioned compound by treatment with methyl sulfate and 10% alkali. One recrystallization from alcohol gave cream colored plates melting at 88°. The yield was 80%.

*Anal.* Calcd. for  $\text{C}_{11}\text{H}_9\text{OI}$ : C, 46.49; H, 3.17. Found: C, 46.8; H, 3.2.

$\beta$ -Methoxynaphthyl- $\alpha$ -magnesium Iodide.—This Grignard reagent was prepared by using the magnesium iodide catalyst prepared according to Gilman's<sup>7</sup> method. The concentration was determined by titration and a conversion as high as 80% was obtained.

Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-carbinol.—The Grignard reagent prepared as described was treated with redistilled benzaldehyde. On decomposition of the addition product the alcohol was obtained. Recrystallization from alcohol in which it was rather soluble gave the pure compound melting at 98° corr.; yield 70%.

(6) Mendola, *J. Chem. Soc.*, **47**, 525 (1885).

(7) Gilman, Peterson and Schulze, *Rec. trav. chim.*, **47**, 19 (1927).

*Anal.* Calcd. for  $C_{18}H_{16}O_2$ : C, 81.79; H, 6.10. Found: C, 81.5; H, 6.0. *Mol. wt.* (Rast method) Calcd. 264. Found: 265.

This alcohol was also obtained by reducing the ketone prepared by the Friedel-Crafts reaction with sodium amalgam. Mixed melting points showed them to be identical.

**Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-ketimine Hydriodide.**—Twenty grams of  $\alpha$ -iodo- $\beta$ -methoxynaphthalene was converted into the Grignard reagent and filtered from the undissolved magnesium. Six grams (0.87 mol) of pure benzonitrile in 25 cc. of ether was slowly added. The addition product first settled as an oil but after refluxing for four hours it changed to a yellow crystalline solid. The ether was decanted and the residue was treated with ice and dilute sulfuric acid. At first the product of hydrolysis separated as an oil but soon solidified to a yellow crystalline mass. When recrystallized from hot water it melted at  $180^\circ$  corr. An alcoholic solution when treated with silver nitrate gave a precipitate of silver iodide. The iodide is soluble in alcohol, benzene, acetone and chloroform as well as hot water. It is sparingly soluble in ether and cold water; yield 90% based on the Grignard concentration.

*Anal.* Calcd. for  $C_{18}H_{16}ONI$ : C, 55.53; H, 4.14; I, 32.79. Found: C, 55.7; H, 4.2; I, 33.0.

The ketimine hydroiodide was remarkably stable. Boiling with dilute hydrochloric acid for two hours resulted in only a 25% hydrolysis to the ketone. This product melted at  $125^\circ$  and was identical with the ketone prepared by methods already described.

**Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-ketimine** was prepared from the hydroiodide by neutralizing in ice-cold alcoholic solution with an equal volume of dilute potassium hydroxide. After standing some hours a coarse granular precipitate of the free ketimine separated. An almost quantitative yield of the base resulted, melting at  $98$ – $99^\circ$ . The free ketimine was very soluble in alcohol, ether and benzene, but was only sparingly soluble in water and petroleum ether. It dissolved in dilute mineral acids on warming with the formation of salts similar to the hydroiodide.

*Anal.* Calcd. for  $C_{18}H_{16}ON$ : C, 82.78; H, 5.75; N, 5.36. Found: C, 82.5; H, 5.8; N, 5.4.

The *phenylhydrazone* could not be prepared directly from the ketone. It was, however, obtained by warming 0.7 g. of the ketimine in 10 cc. of alcohol with 0.5 g. of phenylhydrazine and one cc. of glacial acetic acid. Two cc. of water was added and the mixture allowed to stand. After six hours one gram of material (80% of theoretical) had settled out. It was washed with alcohol and melted at  $183.5^\circ$  corr.

*Anal.* Calcd. for  $C_{24}H_{20}ON_2$ : C, 81.82; H, 5.72; N, 7.95. Found: C, 81.6; H, 5.7; N, 8.35.

**Phenyl-di- $\alpha$ -( $\beta$ -methoxynaphthyl)-carbinol.**—The reaction between the Grignard reagent and methyl benzoate gave largely the ketone melting at  $125^\circ$ , which was extracted from the reaction mass with hot alcohol. The residue proved to be the tertiary alcohol. It was recrystallized from nitrobenzene, washed with hot alcohol and found to melt at  $202$ – $203^\circ$  corr.

*Anal.* Calcd. for  $C_{29}H_{24}O_3$ : C, 82.82; H, 5.76. Found: C, 82.1; H, 5.8. *Mol. wt.* Calcd. 420. Found: 426.

**Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-aminomethane.**—The ketimine was reduced to the amine by the following method. To 100 g. of 2% sodium amalgam was added 40 cc. of dry benzene, 20 cc. of dry ether and 15 cc. of absolute alcohol. To this was added in small portions 8.5 g. of the ketimine. The flask was shaken after each addition. When the ketimine had been added the flask was shaken at five-minute intervals for twenty-five minutes. The organic liquid was decanted, dried with sodium sulfate and evapo-

rated to dryness. This residue was well washed with petroleum ether to remove the coloring matter and twice recrystallized from alcohol. It then melted at  $102^{\circ}$  corr.; yield 70%. The amine was readily soluble in cold benzene and hot alcohol and moderately soluble in cold alcohol, ether and chloroform.

*Anal.* Calcd. for  $C_{18}H_{17}ON$ : C, 82.13; H, 6.46; N, 5.32. Found: C, 82.0; H, 6.6; N, 5.6.

**Schiff Base with Acetone.**—One-half gram of the amine was dissolved in 5 cc. of alcohol. Two cc. of acetone was added and the mixture heated to boiling. After standing one and one-half hours 0.47 g. of material separated. The crystals were washed with alcohol; m. p.  $162^{\circ}$  corr.

*Anal.* Calcd. for  $C_{21}H_{21}ON$ : C, 83.13; H, 6.98; N, 4.62. Found: C, 83.5; H, 7.2; N, 4.97.

**Schiff Base with Benzaldehyde.**—Seven-tenths gram of the amine was dissolved in 8 cc. of hot alcohol. Five-tenths gram of benzaldehyde was added and the solution allowed to stand. After two hours an oil separated which was removed and rubbed with a few drops of alcohol to induce crystallization. The crystals were washed with alcohol. A yield of 0.73 g. melting at  $98^{\circ}$  corr. was obtained.

*Anal.* Calcd. for  $C_{25}H_{21}ON$ : C, 85.43; H, 6.03; N, 3.99. Found: C, 85.7; H, 6.3; N, 4.0.

**N-Acetyl-phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-aminomethane.**—One gram of the amine was dissolved in 10 cc. of benzene and 3 cc. of ether. An excess (0.5 cc.) of acetyl chloride was added and the mixture treated with pyridine. One-half gram melting at  $186.5$ – $187^{\circ}$  was obtained. By mixed melting points this was shown to be the same as the compound obtained by first acetylating and then methylating phenyl- $\beta$ -naphthol-aminomethane.<sup>2</sup>

*Anal.* Calcd. for  $C_{20}H_{19}O_2N$ : N, 4.59. Found: N, 4.7.

**Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-aminomethane Hydrochloride.**—This compound was prepared by treating an alcoholic solution of the amine with dilute hydrochloric acid. It melted with decomposition at  $237$ – $240^{\circ}$ .

*Anal.* Calcd. for  $C_{18}H_{18}ONCl$ : Cl, 11.84. Found: Cl, 12.0.

**Resolution of the Amine.**—One mol (2.53 g.) of the amine was dissolved in 60 cc. of alcohol at  $40^{\circ}$ . To this was added 1.27 g. (one mol) of *l*-malic acid in 10 cc. of alcohol. Crystals soon appeared and after standing for four hours they were filtered and washed with alcohol. A yield of 1.81 g. of the salt melting at  $186^{\circ}$  was obtained. Three more fractions were obtained from the mother liquor, the next to the last being the purest which melted at  $164^{\circ}$ . When dissolved in methyl alcohol the salts showed but slight optical activity.

The salts were treated with potassium hydroxide and extracted with ether. The first fraction showed the highest dextro rotation and gave  $\alpha_D +3.05^{\circ}$ ,  $[\alpha]_D^{25} +197^{\circ}$ , for 0.1550 g. of amine in 10 cc. of ether in a 1-dm. tube.

The third fraction contained the levo rotatory amine and 0.1229 g. of the free base in 10 cc. of ether gave  $\alpha_D -2.49^{\circ}$ ,  $[\alpha]_D^{25} -202^{\circ}$ .

As yet neither of the active forms of the amine has been obtained in a crystalline state. When small amounts of *d*- and *l*-amines were mixed they at once solidified to give the racemic compound.

### Summary

Phenyl- $\alpha$ -( $\beta$ -methoxynaphthyl)-aminomethane has been prepared and resolved into its optical antipodes. Many of the derivatives have also been prepared.

This amine is quite stable in contrast to phenyl- $\beta$ -naphtholaminomethane. This lends weight to the theory that the tautomerism of the hydroxyl group in the latter compound contributes to its instability.

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## The Spatial Configuration of the Valences in Tricovalent Carbon Compounds<sup>1</sup>

BY EVERETT S. WALLIS AND FREDERIC H. ADAMS

The tetrahedral configuration of the valences of quadricovalent carbon has been generally accepted since the classical researches of van't Hoff and Le Bel. However, the spatial arrangement of the groups in compounds containing a tricovalent carbon atom has not been definitely proved. For the sake of clearness in discussion all tricovalent carbon compounds may be divided into three classes: (1) "carbanions"<sup>2</sup>  $\left[ \begin{array}{c} R_1 \\ R_2 : \ddot{C} : \\ R_3 \end{array} \right]^-$ , (2) free radicals  $\left[ \begin{array}{c} R_1 \\ R_2 : \ddot{C} \cdot \\ R_3 \end{array} \right]$ , and (3) carbonium ions  $\left[ \begin{array}{c} R_1 \\ R_2 : \ddot{C} \\ R_3 \end{array} \right]^+$ . Much interest is attached to the possibility of the existence of a non-planar configuration in these compounds. If such a spatial arrangement be true, asymmetry would be possible when the three aryl groups around the central carbon atom are different. A study of the behavior of such compounds toward polarized light would also enable us to determine the degree of stability of the antimeric configurations. It is hardly possible experimentally to resolve such substances directly into *dextro* and *levo* forms. It would be necessary to prepare the corresponding quadricovalent compound in its enantiomorphous modifications, and then to determine whether the rotatory power of such compounds is retained or lost upon transition into the tricovalent state, and return to the quadricovalent condition. If optical activity of the final product is retained, it would necessarily imply that the tricovalent molecule from which it was formed was also optically active. An asymmetric spatial configuration would therefore be experimentally demonstrated. If, however, on assuming the tricovalent state the substituted groups move into the plane of the central carbon atom,

(1) This paper is based upon a thesis submitted by Frederic H. Adams to the Faculty of Princeton University in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Communicated in the form of two papers to the Division of Organic Chemistry at the 83rd and 85th meetings of the American Chemical Society held at New Orleans, La., March 28 to April 1, 1932, and at Washington, D. C., March 26 to 31, 1933, respectively.

(2) The above word is here proposed for a negatively charged carbon ion in contrast to the term "carbonium," which indicates a positively charged ion.