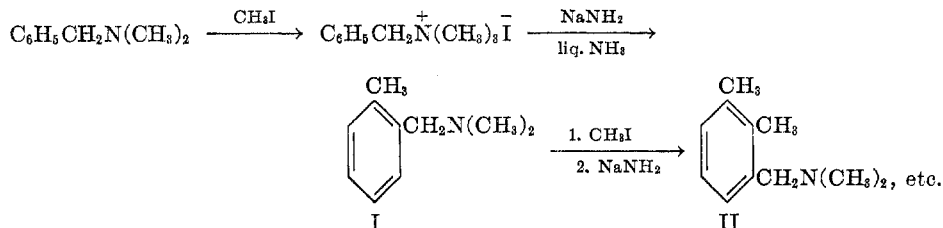


A NEW METHOD FOR THE PREPARATION OF 2-METHYL- AND 2,3-DIMETHYL-BENZYL ALCOHOLS AND THEIR ACETATES<sup>1</sup>

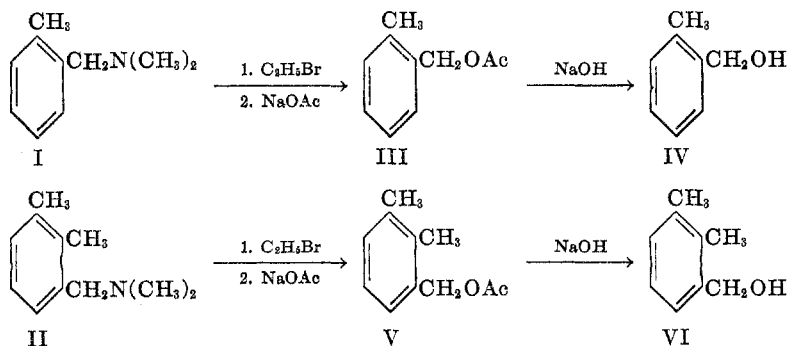
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It has recently been shown (1) that the methiodide of benzyldimethylamine may be converted to 2-methylbenzyldimethylamine (I) by means of sodium amide in liquid ammonia, and that the methiodide of the latter amine may be further rearranged to 2,3-dimethylbenzyldimethylamine (II) in good over-all yield. Moreover, this progressive introduction of vicinal methyl groups into the benzene ring may be repeated until the completely substituted product is formed.



It was further shown (1) that certain of the methyl-substituted tertiary amines obtained by such rearrangements may be converted in good yields to carboxylic acids by oxidation, and to hydrocarbons by reduction of the methiodide. For example, tertiary amine II was converted to 2,3-dimethylbenzoic acid and to hemimellitine. However, the conversion of amine II to 2,3-dimethylbenzyl alcohol by the thermal decomposition of the quaternary ammonium hydroxide was unsatisfactory. Only a 4% yield of the alcohol was isolated, and much high-boiling material, resulting apparently from further reaction of the alcohol with the alkali, was obtained.



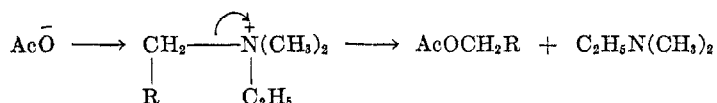
In the present investigation tertiary amines I and II, prepared from benzyldimethylamine as represented above, were converted through their ethyl bromide

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salts to acetates III and V by means of sodium acetate in glacial acetic acid. The acetates were then converted to alcohols IV and VI by saponification. The yields of the acetates from the tertiary amines were 91–94%, and those of the alcohols from the acetates, 96%. The over-all yields of alcohol IV and VI from benzyldimethylamine, which is available commercially, were 77% and 50% respectively.

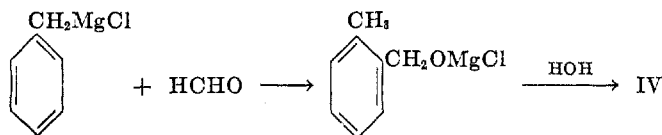
Tertiary amine I was also converted to acetate III through the methiodide but this reaction was accompanied by the liberation of some iodine which complicated the isolation of the acetate. Moreover, the methiodide was less soluble than the bromide in acetic acid, and the isolation of the product was facilitated by the use of the minimum of the solvent.

The mechanism for the conversion of the ethyl bromide salts of tertiary amines I and II to the corresponding acetates involves presumably the  $S_N2$  type of displacement which may be illustrated by the following general reaction where R represents the 2-methylbenzyl or 2,3-dimethylbenzyl group.



It should be mentioned that  $\beta$ -elimination, which is the more characteristic mode of reaction with quaternary ammonium hydroxides having the ethyl group, was not observed in the present reaction with the relatively weakly basic acetate ion.

The present method of preparation of alcohols IV and VI is superior not only to the thermal decomposition of the quaternary ammonium hydroxides but also to that involving the "abnormal" Grignard reactions of benzylmagnesium chloride and its *o*-methyl derivative with formaldehyde, which may be illustrated by the following equation (2).



Although this Grignard method produces the alcohols more directly, they are obtained contaminated with the "normal" products which are difficult to remove (3, 4). Our method not only gives the pure alcohols, but the yields, particularly for alcohol VI, are better.

The present method should be applicable also to the preparation of higher vicinal methyl alcohols and their acetates. This of course would involve the preliminary rearrangement of the methiodide of tertiary amine II and further such rearrangements if the more highly substituted products are desired. Moreover, the corresponding monocarboxylic acids may be prepared readily by the oxidation of the alcohols. The two alcohols obtained in the present work, IV and VI, were oxidized to *o*-toluic acid and 2,3-dimethylbenzoic acid in yields of 82% and 90%, respectively. Although these acids have been obtained by the direct

oxidation of amines I and II in good yields (67% and 74% respectively), the oxidation of the alcohols may be effected somewhat more readily.

#### EXPERIMENTAL

*Ethyl bromide salts of 2-methylbenzyl dimethylamine (I) and 2,3-dimethylbenzyl dimethylamine (II).* Tertiary amine I (b.p. 198–199°) was prepared in 90% yield from benzyl dimethylamine (b.p. 177–178°) through its methiodide, and tertiary amine II (b.p. 97–99° at 13 mm.) was prepared in 62% yield from tertiary amine I through its methiodide, according to a method described previously (1).

A solution of 37 g. (0.25 mole) of tertiary amine I and 33 g. (0.28 mole) of ethyl bromide in 50 ml. of absolute methanol was refluxed for one hour. The excess ethyl bromide and methanol were removed at the aspirator and 200 ml. of ether was added to the oily residue. The insoluble oil crystallized on scratching. The crystals were collected and washed with ether to yield 62 g. (92%) of 2-methylbenzyl dimethylethylammonium bromide.

In a similar manner, 41 g. (0.25 mole) of tertiary amine II was converted to 65 g. (92%) of 2,3-dimethylbenzyl dimethylethylammonium bromide.

Since these salts were quite hygroscopic they were stored in a desiccator over calcium chloride.

*2-Methylbenzyl acetate (III) and 2-methylbenzyl alcohol (IV).* A solution of 38.7 g. (0.15 mole) of 2-methylbenzyl dimethylethylammonium bromide and 24.6 g. (0.3 mole) of freshly fused sodium acetate in 100 ml. of glacial acetic acid was refluxed for 24 hours. The solution was cooled and diluted with an equal volume of water. The mixture was neutralized with sodium bicarbonate, and extracted with three 100-ml. portions of ether. The combined ether extracts were washed with dilute hydrochloric acid, then with sodium bicarbonate, and dried over sodium sulfate. The solvent was removed and the residue was distilled to give 22.4 g. (91%) of 2-methylbenzyl acetate (III), b.p. 119–121° at 15 mm., (reported b.p. 118–119° at 20 mm.) (5).

A mixture of 16.4 g. (0.1 mole) of the 2-methylbenzyl acetate and 4.8 g. (0.12 mole) of sodium hydroxide in 150 ml. of 30% ethanol was refluxed for 12 hours. The resulting mixture was cooled and extracted with three 75-ml. portions of ether. The combined ether extracts were dried over sodium sulfate and the solvent was removed. The residue was dissolved in 50 ml. of 30–60° petroleum ether and cooled. The resulting crystals of 2-methylbenzyl alcohol (IV) were collected and dried in air. The product (11.7 g., 96%) melted at 35–36° (reported m.p. 35°) (3).

*Oxidation of 2 g. (0.019 mole) of the 2-methylbenzyl alcohol with 4 g. of potassium permanganate in 50 ml. of acetone and 20 ml. of water at room temperature gave 2.18 g. (83%) of 2-methylbenzoic acid, m.p. 103–104° (reported m.p. 102–103°) (6).*

*2,3-Dimethylbenzyl acetate (V) and 2,3-dimethylbenzyl alcohol (VI).* A solution of 48.5 g. (0.172 mole) of 2,3-dimethylbenzyl dimethylethylammonium bromide was refluxed with 28.7 g. (0.35 mole) of fused sodium acetate in 110 ml. of glacial acetic acid for 24 hours. The mixture was worked up by the method described above for acetate III to yield 28.8 g. (94%) of 2,3-dimethylbenzyl acetate, b.p. 127–129° at 9 mm.

*Anal.*<sup>2</sup> Calc'd for  $C_{11}H_{16}O_2$ : C, 74.12; H, 7.92.

Found: C, 74.38; H, 8.17.

The procedure described above for acetate III was used for the hydrolysis of 17.8 g. (0.1 mole) of 2,3-dimethylbenzyl acetate (V) to yield 13.1 g. (96%) of 2,3-dimethylbenzyl alcohol (VI), which, after one recrystallization from 50 ml. of 60–90° ligroin, melted at 65–66° (reported m.p. 65–66.5°) (4).

*Oxidation of 2 g. (0.015 mole) of 2,3-dimethylbenzyl alcohol with 4 g. potassium permanganate yielded 2 g. (90%) of 2,3-dimethylbenzoic acid, m.p. 142–143° (reported m.p. 144°) (2).*

<sup>2</sup> Clarke Microanalytical Laboratories, Urbana, Illinois.

## SUMMARY

A new method for the preparation of vicinal methyl benzyl alcohols has been discovered. The corresponding amines, made by the *ortho* substitution rearrangement of quaternary ammonium salts, were converted *via* the ethyl bromide salts to the acetates, which were hydrolyzed to the alcohols.

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