avian malaria, nor was any detectable difference in toxicity for mice observed.

RESEARCH LABORATORIES
MERCK & CO., INC.
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Preparation of 3-Cyano-4-piperidone

BY G. BRYANT BACHMAN AND R. S. BARKER

Although N-substituted 4-piperidones have been prepared in satisfactory yields by cyclization procedures from N-alkyl-di-(β-carbethoxyethyl)-amines[1] and from N-alkyl-di-(β-cyanoethyl)-amines,[2] results with the N-unsubstituted analogs have been less gratifying.[3] We have found that di-(β-cyanoethyl)-amine may be converted to 3-cyano-4-piperidone in 70% yield by cyclizing in the presence of sodium, sodium amide or sodium alcoholates, followed by hydrolysis of the intermediate 3-cyano-4-iminopiperidine. When sodium is used as the catalyst it is desirable to use a solvent of the ether class (*e. g.*, dioxane) and to employ a metal carrier (*e. g.*, naphthalene).

Acknowledgment.—The authors are indebted to Eli Lilly and Company for financial support.

Experimental

3-Cyano-4-iminopiperidine.—Dioxane, 400 ml., distilled from sodium, was charged into a 3-neck flask equipped with a nitrogen inlet, a reflux condenser and drying tube, and an efficient stirrer. Naphthalene, 25 g., sodium, 2 g., and bis-(β-cyanoethyl)-amine,[4] 50 g., were added and the air was displaced by nitrogen. The mixture was stirred several hours on a steam-bath. The pale yellow solution gradually became cloudy and precipitated an amorphous brown solid. The product was worked up in two different ways.

Method A.—The hot reaction mixture was poured into one liter of benzene, cooled and filtered. The uncyclized amine is soluble in benzene, whereas the imine is not. The product was crystallized from ethanol, m. p. 187–188° (dec.). It can also be crystallized readily from acetone or from a mixture of dioxane and alcohol (9:1).

Method B.—The hot dioxane mixture was diluted with about 10% by volume of hot alcohol and the product allowed to crystallize. For the hydrolysis to the piperidone either the benzene or dioxane–alcohol precipitate can be used satisfactorily.

Anal. Calcd. for $C_6H_5N_3$: C, 58.48; H, 7.35; N, 34.10. Found: C, 58.46, 58.55; H, 7.21, 7.30; N, 34.05, 34.12.

Phenyl isothiocyanate derivative had a m. p. 170–171° (dec.).

Anal. Calcd. for $C_{13}H_{14}N_4S$: S, 12.37. Found: S, 12.26, 12.32.

3-Cyano-4-piperidone.—3-Cyano-4-iminopiperidine, 50 g., and 150 ml. of 5 *N* hydrochloric acid were heated to 100° for twenty minutes. The solution was cooled and neutralized to *p*H 4–5 with concentrated sodium hydroxide solution, keeping the temperature below 30°. The fine white crystals were filtered, more sodium hydroxide was added to *p*H 6–7, and the product was again filtered. This process was repeated until the filtrate became alkaline to litmus paper. The crystalline product, after washing with water and alcohol, weighed 41 g. (82% yield). To recrystallize the product it was dissolved in aqueous ammonia and vacuum distilled (water pump) on a steam-bath. The first crop of crystals appeared after half the solution had been distilled. It was filtered off and the filtrate was further concentrated to obtain a second and a third crop. The product was washed with water and alcohol. It gave a red-brown color with ferric chloride but showed no definite m. p. It was amphoteric and the titration curve showed a break at *p*H 3.1.

Anal. Calcd. for $C_6H_4ON_2$: C, 58.05; H, 6.49; total N, 22.57; amino N, 11.29. Found: C, 57.82, 57.93; H, 6.50, 6.53; total N, 22.53, 22.47; amino N (by potentiometric titration), 11.1, 11.2.

(1) McElvain and Stork, THIS JOURNAL, **68**, 1049 (1946).
(2) Cook and Reed, *J. Chem. Soc.*, 399 (1945).
(3) Kuettel and McElvain, THIS JOURNAL, **53**, 2692 (1931).
(4) Wiedeman and Montgomery, *ibid.*, **67**, 1995 (1945).

DEPARTMENT OF CHEMISTRY
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Cyanoacetal—A Correction

BY WALTER H. HARTUNG AND HOMER ADKINS

We reported in 1927 that we had obtained cyanoacetal[1] through the reaction of bromoacetal with potassium cyanide in an alcohol–water solution containing potassium iodide. Jacob van de Kamp and others have called our attention to the fact that they had been unable to obtain cyanoacetal by following the procedure described by us. Uhle and Jacobs[2] obtained cyanoacetal in 14% yield by carrying out the reaction in a manner similar to that described in our paper. They worked on a larger scale and followed a different procedure in isolating the desired product. Uhle and Jacobs graciously ignored our paper although it is clear from a comparison of the data in the two papers, that we had not isolated cyanoacetal. Since we did not have cyanoacetal in hand, the figure for the equilibrium constant reported in our paper for the reaction

$$CNCH_2CH(OC_2H_5)_2 + H_2O \rightleftharpoons CNCH_2CHO + 2C_2H_5OH$$

is not significant. We regret very much our mistake and appreciate the forbearance of our friends.

Robert L. Clarke and S. M. McElvain, of this Laboratory, have obtained the same results as those reported by Uhle and Jacobs. They will publish their results in the near future as well as a description of their preferred procedure whereby cyanoacetal was prepared in excellent yield by a series of reactions through $(C_2H_5O)_2CHCH_2CO_2C_2H_5$.

(1) Hartung and Adkins, THIS JOURNAL, **49**, 2520 (1927).
(2) Uhle and Jacobs, *J. Org. Chem.*, **10**, 81 (1945).

UNIVERSITY OF WISCONSIN
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Equilibrium Studies on the Dehydrogenation of Primary and Secondary Alcohols. II. Cyclohexanols

BY ADRIAN H. CUBBERLEY AND MAX B. MUELLER

Free energies, heats and entropies of dehydrogenation of a number of alcohols were recently reported from this Laboratory.[1]

Further results obtained using the same appara-

(1) Cubberley and Mueller, THIS JOURNAL, **68**, 1149 (1946).