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INDICATIONS FOR THE OCCURRENCE OF 2,3-PYRIDYNE AS AN INTERMEDIATE

R.J. Martens and H.J. den Hertog

Laboratory of Organic Chemistry of the Agricultural University

Wageningen, The Netherlands

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THERE is evidence for 3,4-pyridyne (I) occurring as an intermediate in several reactions, i.e. the reaction of 3-bromopyridine with sodium amide in liquid ammonia in the presence of acetophenone,[1] the reaction of 3-chloropyridine with lithium piperidide in piperidine,[2,3,4] the reaction of pyridine-3-diazonium-4-carboxylate with furan.[3] 3,4-Pyridyne originates also from 3-chloro, 3-bromo and 3-iodopyridine (II) as well as from the 4-isomers (III) when these substances are reacted with potassium amide in liquid ammonia, in all reactions a mixture of 3- and 4-aminopyridine (IV and V) of the same composition (ratio ~ 1:2) being obtained.[5,6]

There is neither indication for the formation of 2,3-pyridyne from the reaction of 2-fluoropyridine with lithium piperidide and piperidine,[3] nor from the reactions of 2-chloro, 2-bromo and 2-iodopyridine with potassium amide in liquid ammonia,[5,6] only derivatives substituted at the 2-position being formed. A reaction which might proceed via a derivative of 2,3-pyridyne is the amination of 3-bromo-4-ethoxypyridine.[5,6] In this substance

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[1] R. Levine and W.W. Leake, Science 121, 780 (1955).

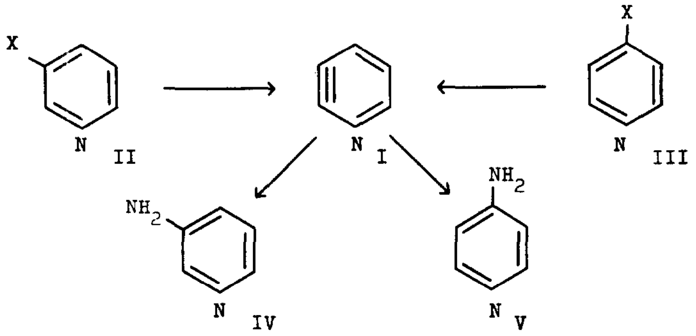
[2] Th. Kauffmann and F.-P. Boettcher, Angew. Chem. 73, 65 (1961).

[3] Th. Kauffmann and F.-P. Boettcher, Chem. Ber. 95, 949 (1962).

[4] Cf. R. Huisgen, Organo-Metallic Chemistry 36 (1960).

[5] M.J. Pieterse and H.J. den Hertog, Rec. Trav. Chim. 80, 1376 (1961).

[6] M.J. Pieterse, Thesis Amsterdam 1962.



the bromine atom cannot easily be replaced by the amino group according to an addition-elimination mechanism, while the presence of the ethoxy group at the 4-position prevents the formation of 3,4-pyridyne. Possibly 4-ethoxy-2,3-pyridyne acts as an intermediate in this case, 2-amino-4-ethoxypyridine being formed as the chief product. Analogously 2-amino-4,6-diethoxypyridine results from the amination of 3-bromo-4,6-diethoxypyridine via 4,6-diethoxy-2,3-pyridyne.[6]

In order to prove that 2,3-pyridyne (VI) can occur as an intermediate, we tried to react 3-bromo-2-chloropyridine (VII) with lithium amalgam in the presence of furan in analogy to the reaction of *o*-fluorobromobenzene with the same reagents by Wittig and Pohmer,[7] and the conversion of 3-bromo-4-chloropyridine by Kauffmann and Boettcher, yielding isoquinoline.

4.4 g of 3-bromo-2-chloropyridine was shaken with lithium amalgam prepared from 150 g of mercury and 0.45 g of lithium, and 45 ml of furan under nitrogen for 7 days at 25° in a sealed tube. The reaction mixture was stirred with dilute sulphuric acid and filtered whereupon the filtrate was basified and extracted with ether. After distilling off the solvent 1.5 g of a liquid was left which was analysed by gaschromatography using a copper column filled with 20 per cent Apiezon L on Embacel and hydrogen as

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[7] G. Wittig and L. Pohmer, Angew. Chem. 67, 348 (1955).

carrier gas. It was found to contain quinoline (VIII) together with other substances i.a. 3-bromopyridine and in a larger amount, 2-chloropyridine. The identity of quinoline was established by its retention time, infrared and ultra-violet absorption spectra and the mixed melting point of its picrate.

The formation of quinoline (VIII) from 3-bromo-2-chloropyridine (VII) can be explained by assuming a series of reactions involving 2,3-pyridyne (VI) as an intermediate. First VII is converted into the pyridyne VI. This compound reacts with furan according to an addition reaction yielding the endoxide IX. Thereupon, the oxygen atom is abstracted from IX by lithium and quinoline (VIII) is formed.