manner. After sublimation the product melted at 113–114°

Anal. Calcd. for $C_8H_{16}O_2$: C, 66.63; H, 11.18. Found: C, 66.45; H, 11.29.

Degradation of hydroxyethylcyclohexyl carbamate (III) *to 1-ethylcyclohexane-1,4-diol* (VII-B). This conversion was carried out by two different methods, refluxing for 1 hr. with excess lithium aluminum hydride in benzene and by basic hydrolysis with lithium hydroxide. The identical product was obtained in each case. The latter procedure is described here:

Ten milligrams of hydroxyethylcyclohexylcarbamate (III), prepared from the human metabolite as described previously,[2] was refluxed for 10 min. with 1*N* lithium hydroxide. After cooling, the reaction mixture was extracted with ether, and the ether extract was evaporated to dryness. Sublimation of the residue at 65° (0.1 mm.) gave a crystalline solid, m.p. 110–112°. When mixed with 1-ethylcyclohexane-1,4-diol (VII-A), the melting point was depressed to 76–81°. Upon admixture with VII-B, however, the melting point was not depressed (112–113°). The X-ray crystallographic pattern and infrared spectrum were identical to that of 1-ethylcyclohexane-1,4-diol (isomer VII-B).

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Some Reactions of 1-Methoxypyridinium Salts and a Color Test for *N*-Oxides

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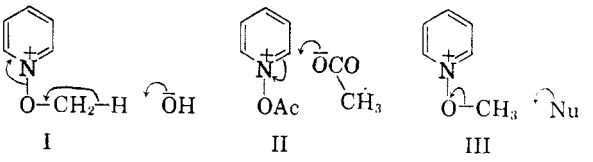
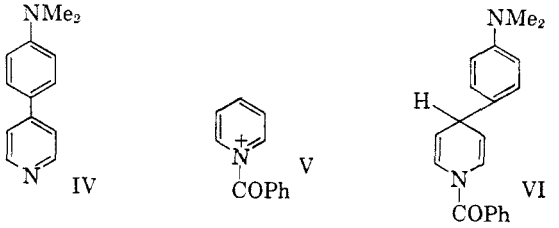
1-Alkyloxypyridinium salts react (*cf.* structure I) with hydroxide ion to give pyridine and an aldehyde,[1–3] but many reactions are known in which pyridine 1-oxide derivatives are attacked in the α- or γ- positions of the ring by nucleophilic reagents,[4] as in *e.g.*, structure II. In an attempt to effect a reaction of this type, 1-methoxypyridinium toluene-*p*-sulfonate was treated with a series of nucleophilic reagents.* Sodium ethoxide and sodium phenoxide gave pyridine in good and poor yield, respectively. Sodium acetate, benzyl mercaptan, morpholine, aniline, hydroxylamine, semicarbazide, and phenyl magnesium bromide gave pyridine 1-oxide in 15–56% yield. The 1-methoxypyridinium ion acts here as a methylating agent (structure III) and *N*-methylaniline was isolated as the toluene-*p*-sulfonamide from the reactions with aniline. This appears to be the first time that 1-alkoxylpyridinium salts have been dealkylated without concomitant loss of the *N*-oxide oxygen atom.



I II III

Treatment of pyridine with benzoyl chloride and dimethylaniline yields 4-(*p*-dimethylaminophenyl) pyridine (IV),[5] probably by addition of dimethylaniline to V followed by aromatization of VI. It appeared that an analogous reaction could occur with pyridine 1-oxide; however, this compound behaved as an oxidizing agent and gave crystal violet probably admixed with methyl violet by releasing formaldehyde or its equivalent from dimethylaniline which then combined with further molecules of dimethylaniline. When pyridine 1-oxide hydrochloride and dimethylaniline were heated together, the same blue color was formed.



IV V VI

The production of a blue color on gently heating with dimethylaniline and hydrochloric acid was found to be a convenient color test for *N*-oxides and also for nitro compounds. Crystal violet is formed from dimethylaniline, *via* an oxidative dealkylation to formaldehyde, by many inorganic oxidizing agents,[6–8] *e.g.*, $KClO_3$, Mn_3O_4, $Cu(NO_3)_2$, H_2O_2. Of organic compounds, benzene sulfonyl chlorides react slowly.[9] Peroxides give colors with dimethylaniline.[10] Nitro compounds, and especially polynitrocompounds, form yellow or orange-red charge transfer complexes with dimethylaniline.[11,12]

Methyl ketones give a violet coloration with *m*-dinitrobenzene and methanolic alkali[13]; this reaction is also given by α-methyl-chromones and -pyrones.[14] Neither 2-, 3-, or 4-methylpyridines nor their 1-oxides gave a similar coloration under these conditions; however, 1,2- (VII) and 1,4-, but not 1,3-dimethylpyridinium ions and 1-methoxy-2- (VIII) and 1-methoxy-4-methylpyridinium ions showed a positive reaction.

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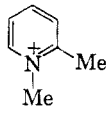
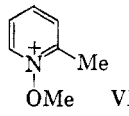


VII



VIII

EXPERIMENTAL

Reactions of 1-methoxypyridinium toluene-p-sulfonate (IX). (a) IX (2.65 g., prepared by the lit. method[2]) and ethanolic sodium ethoxide (from 0.23 g. sodium and 10 cc. ethanol) were refluxed for 1 hr., cooled in methanol–Dry Ice, and filtered; hot ethanolic picric acid (2.29 g.) added to the filtrate gave pyridine picrate (3.1 g., 81%), m.p. and mixed m.p. 163–164° after recrystallization from ethanol.

(b) Ethanolic sodium phenoxide gave pyridine (20%, isolated as the picrate).

(c) IX (2.65 g.), hydroxylamine hydrochloride (1.4 g.), and anhydrous sodium carbonate (5.3 g.) were refluxed for 1 hr. in 10 cc. of water, and filtered at 0°. Evaporation of the filtrate at 100°/30 mm., extraction of the residue with ethanol (20 cc.), and treatment of the extracts with picric acid (2 g.) gave pyridine 1-oxide picrate (3.2 g., 55%), m.p. and mixed m.p. 178.5–179° (lit.[15] m.p. 179.5°).

(d) IX (2.65 g.) and aniline (2.8 g.) were heated at 120° for 16 hr., treated with aqueous potassium hydroxide (4.4 cc., 30%), and the organic layer separated and distilled. The fraction which boiled below 80°/0.1 mm. was heated for 10 min. at 100° with pyridine (1 cc.) and toluene-*p*-sulfonyl chloride (1 g.), aqueous sodium hydroxide was added and the oily layer removed and acidified to give *N*-methyl toluene-*p*-sulfonanilide (15%), m.p. and mixed m.p. 95–96°. The fraction which boiled above 80°/0.1 mm. with ethanolic picric acid gave pyridine 1-oxide picrate, m.p. and mixed m.p. 177–178.5°.

(e) Under conditions similar to those described in (a), (c), or (d), pyridine 1-oxide picrate was obtained from 1-methoxypyridinium toluene-*p*-sulfonate with the following reagents in the yields indicated: ethanolic sodium benzyl mercaptide, 35%; sodium acetate in acetic acid, 30%; morpholine, 23%; aqueous semicarbazide, 28%; and ethereal phenyl magnesium bromide, 15%.

Reaction of pyridine 1-oxide hydrochloride with dimethylaniline. Pyridine 1-oxide hydrochloride (6.5 g.) and dimethylaniline (1.5 g.) were heated for 1 hr. at 165° and chromatographed in benzene-chloroform on alumina. Elution with chloroform-ethanol and rechromatographing gave crystal violet (identified by infrared spectrum).

Color test for N-oxides. General procedure: dimethylaniline (0.2 cc.), concentrated hydrochloric acid (0.05 cc.), and the material to be tested (0.1 g.) were boiled in a test tube for 1 min. Ethanol (1 cc.) was added to the cooled residue; if positive an intense blue color developed.

The following substituted pyridine 1-oxides gave a positive result: 2-, 3-, and 4-methyl, 2-, 3-, and 4-cyano, 3- and 4-nitro, 2-amino, and 2- and 3-hydroxy, 2,6-dimethyl, 2,4,6-trimethyl, 3-methyl-4-nitro, 4-ethoxy-3-nitro. Quinoline 1-oxide, nitrobenzene, and *m*-dinitrobenzene also gave a positive result.

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