Non-benzenoid Aromatic Heterocycles. III[1]. *Conversion of 4-Pyrone Derivatives into 4-Pyridone Derivatives*

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In the first paper of this series[2], the condensation of active methylene compounds with 2, 6-dimethyl-4-pyrone has been reported. In the present communication, the action of amines on these condensation products is described. These compounds are similar to pyrone in their electronic structure, and it is of interest to examine if these compounds are converted into the corresponding pyridone derivatives like pyrones. If the reaction takes place, it will be a valuable route to many pyridone derivatives. As model compounds, 4-(dicyanomethylene)-2, 6-dimethyl-4*H*-pyrane (Ia) and 4-(ethoxycarbonylcyanomethylene)-2, 6-dimethyl-4*H*-pyrane (Ib) were selected. With Ia, the reaction with amines (aniline, benzylamine, hydrazine hydrate) took place and gave the corresponding *N*-substituted 4-(dicyanomethylene)-2, 6-dimethyl-1, 4-dihydropyridines (IIa-c). As to the structure of the reaction product with hydrazine hydrate, two structures, IIc and III, are possible, but the *N*-aminopyridone structure (IIc) was established by condensing it with benzaldehyde to form the benzal derivative (IIg). Although Ia did not react with ammonium chloride, it was converted into pyridone derivative (IId) by heating it in formamide. Of special interest is IId, since it may be isomerized to pyridine derivative IV and would afford a valuable route to many pyridine derivatives*.

Starting from Ib, the corresponding pyridone derivatives (IIe, f) were prepared with benzylamine and hydrazine hydrate, but with aniline or formamide, the starting material was recovered unchanged. It may be worth while to note that the ester group of Ib did not suffer amminolysis.

An attempt to prepare 1-thiapyrone derivatives by treatment of Ia and Ib with potassium hydrosulfide was not successful.

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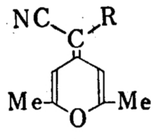
[1] Part II. H. Kato, T. Ogawa and M. Ohta, This Bulletin, 33, 1467 (1960).

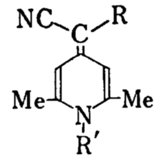
[2] M. Ohta and H. Kato, ibid., 32, 707 (1959).

* After the completion of this work, a review on pyrylium salt by Dimorth[3] appeared, where he briefly reported that he also attempted the reaction of this type and obtained the corresponding pyridine derivatives.

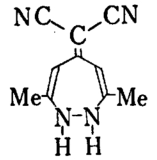
[3] K. Dimroth, *Angew. Chem.*, 72, 331 (1960).



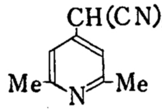
Ia : R=CN
Ib : R=COOEt



IIa : R=CN, R'=Ph
IIb : R=CN, R'=PhCH$_2$
IIc : R=CN, R'=H$_2$N
IId : R=CN, R'=H
IIe : R=COOEt, R'=PhCH$_2$
IIf : R=COOEt, R'=H$_2$N
IIg : R=CN, R'=N=CHPh



III



IV

Experimental

Reaction of Ia or Ib with Amines.—IIa, A mixture of Ia (3.5 g.) and an excess of aniline (4 g.) was gently refluxed for an hour. The reaction mixture was washed with dil. hydrochloric acid and the residue (1.0 g., m. p. 310∼313°C) was recrystallized from acetic acid giving white needles, m. p. 314∼315°C. Yield 20%.

Found: N, 17.11. Calcd. for C$_{16}$H$_{13}$N$_3$: N, 16.99%. Similarly, the following compounds were obtained:

IIb, (from Ia and benzylamine; heated at 150°C.) yellow needles (recrystallized from ethanol) m. p. 242∼245°C. Yield 34%.

Found: N, 16.28. Calcd. for C$_{17}$H$_{15}$N$_3$: N, 16.08%.

IIc (from Ia and hydrazine hydrate; heated at 100°C) white needles (recrystallized from acetic acid) m. p. 291∼292°C (decomp.) Yield 40%.

Found: N, 30.36. Calcd. for C$_{10}$H$_{10}$N$_4$: N, 30.09%.

IIe, (from Ib and benzylamine) white needles (recrystallized from ethanol) m. p. 183∼184°C. Yield 80%.

Found: N, 9.15. Calcd. for C$_{19}$H$_{20}$O$_2$N$_2$: N, 9.09%.

IIf, (from Ib and hydrazine hydrate) pale yellow needles (recrystallized from ethanol) m. p. 217∼218°C. Yield 71%.

Found: N, 17.70. Calcd. for C$_{12}$H$_{15}$O$_2$N$_3$: N, 18.02%.

N-Benzalamino-4-(dicyanomethylene)-2,6-dimethyl-1,4-dihydropyridine (IIg),—A solution of IIc (0.6 g.) and benzaldehyde (0.4 g.) in acetic acid was refluxed for an hour, and then diluted with water and the precipitate that separated out was collected (0.6 g., m. p, 254∼255°C). Recrystallization from acetic acid afforded yellow needles, m. p. 294∼295C°.

Found: C, 74.21; H, 5.25; N, 20.00. Calcd. for C$_{17}$H$_{14}$N$_4$: C, 74.43; H, 5.14; N, 20.43%.

4-(Dicyanomethylene)-2,6-dimethyl-1,4-dihydropyridine (IId).—A solution of Ia (5 g.) in formamide (5 g.) was heated at 150°C for an hour. The crystals which separated out on cooling were collected (1.7 g., m. p. 280∼300°C) and recrystallized from formic acid giving yellow needles, m. p. 330∼331°C.

Found: C, 70.37; H, 5.36; N, 24.44. Calcd. for C$_{10}$H$_9$N$_3$: C, 70.15; H, 5.30; N, 24.55%.

Reaction of Potassium Hydrosulfide with Ia or Ib,—When Ia or Ib was refluxed in methanol solution of potassium hydrosulfide, the starting material was recovred unchanged.

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