A Chloro-imine from the Action of Phosphorus Pentachloride on 2-Acetamido-1,3,4,6-tetra-*O*-acetyl-2-deoxy-β-D-glucopyranose

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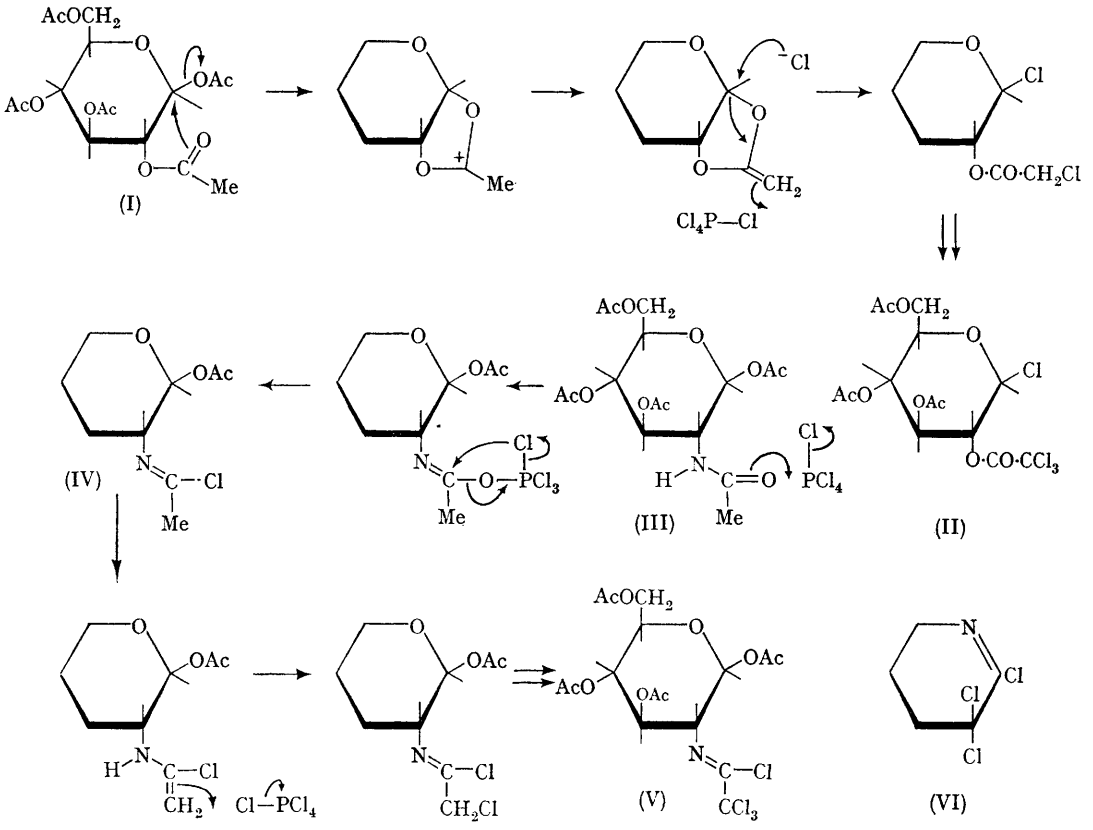
REACTION of phosphorus pentachloride with 1,2,3,4,6-penta-*O*-acetyl-β-D-glucopyranose (I) yields 3,4,6-tri-*O*-acetyl-2-trichloroacetyl-β-D-glucopyranosyl chloride (II)[1,2] as the final product (40%). In a similar reaction with 2-acetamido-1,3,4,6-tetra-*O*-acetyl-2-deoxy-β-D-glucopyranose (III) we obtained a highly crystalline product (V), $C_{16}H_{19}Cl_4NO_9$, in 65% yield {m.p. 164—165°; $[\alpha]_{365}$ −6° (chloroform); *M* (v.p. osmometer): 504 ± 5; required:511}. The absence of a halide function at C-1 in (V) was indicated by a negative reaction with silver nitrate in aqueous acetone and by the isolation of 1,3,4,6-tetra-*O*-acetyl-2-amino-2-deoxy-β-D-glucopyranose hydrochloride on hydrogenation with Raney nickel in ethanol. Treatment with 4N-hydrochloric acid at 100° gave 2-amino-2-deoxy-D-glucose hydrochloride. The n.m.r. spectrum (in deuterochloroform), which was consistent with the *gluco*-configuration, showed four acetoxymethyl singlets, but no N–H signal, and the H-1 doublet (τ 4·2; *J* 8 c./sec.) indicated a β-configuration at C-1. Compared with that of the starting material (III) the infrared spectrum of (V) showed an N=C absorption at 1685 cm.$^{-1}$ and poly-chlorine substitution bands at 750 and 780 cm.$^{-1}$, but neither N–H bands at 3270 and 1560 cm.$^{-1}$ nor amide carbonyl stretch at 1660 cm.$^{-1}$.

On this evidence and by analogy with the reaction of piperidone with phosphorus pentachloride to give the trichloro-imine (VI),[3] we assign the structure (V) to our product, namely 1,3,4,6-tetra-*O*-acetyl-2-deoxy-2-tetrachloroethylidene-amino-β-D-glucopyranose. Although there was no molecular ion in the mass spectrum the highest peak at *m/e* 474 showed a typical trichloro-substitution pattern and arises by the loss of the unique chlorine substituent (*m/e* 35). Lemieux and Huber[4] suggested that the trichloroacetate (II) is formed from (I) *via* 1,2-cyclic oxycarbonium ions formed by participation of the carbonyl group at C-2, thereby proceeding successively to the 2-chloroacetate, the 2-dichloroacetate, and subsequently the 2-trichloroacetate. However, the formation of the cyclic ion at each stage in the process becomes successively more difficult as a result of increased electron-withdrawal as each chlorine substituent is introduced. It seems unlikely, therefore, that the chloroacetates would participate to form cyclic ions in this reaction. This view is supported by the observation[5] that the rate of exchange of the 1-acetoxy-group,



labelled with ^{14}C, of (I) in acetic acid–acetic anhydride (1 : 1, containing 0·5M-sulphuric acid) is one hundred times faster than that of 1,3,4,6-tetra-*O*-acetyl-2-dichloroacetyl-β-D-glucopyranose. Consequently, after the first step, chlorination could proceed by an alternative mechanism. A cyclic ion mechanism cannot be operative in the reaction of (III) with phosphorus pentachloride because the 1-acetoxy-group is preserved. Further, 2-trichloroacetamido-1,3,4,6-tetra-*O*-acetyl-β-D-glucopyranose (m.p. 166·5—167·5°, the previous preparation[6] of which is obviously impure) did not give (V) on treatment with phosphorus pentachloride and is not, therefore, an intermediate. This observation suggests that the unique chlorine atom is the first to enter to give the intermediate (IV) which would rapidly be further chlorinated.

However treatment of (±)-*trans*-2-acetamido-1-acetoxycyclohexane with phosphorus pentachloride gave, amongst other products, (±)-*trans*-1-acetoxy-2-trichloroacetamidocyclohexane (m.p. 90—91°) and (±)-*trans*-1-acetoxy-2-dichloroacetamidocyclohexane (m.p. 116—117°). A similar reaction with 2-acetamido-1-acetoxyethane yielded 1-acetoxy-2-dichloroacetamidoethane (m.p. 79—80°). Thus although the acetoxy-groups are retained as in the case of the 1-acetoxy-group in (V), a chloro-imine is clearly not an obligatory intermediate in the chlorination of acetamido-groups.

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