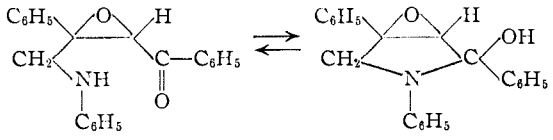
ment with HCl. On the other hand, although the α-isomers were less reactive under the same conditions, the pyrrole appeared to form *directly* when reaction did take place. The latter result was interpreted as evidence that the spacial arrangement of CH_2X (X = Cl, Br) and COC_6H_5 groupings in the α-isomers was sterically unfavorable for displacement of halogen, but once displacement had taken place the orientation of CH_2X (X = NHC_6H_5) and COC_6H_5 groupings was favorable for pyrrole formation, and therefore, *cis*.

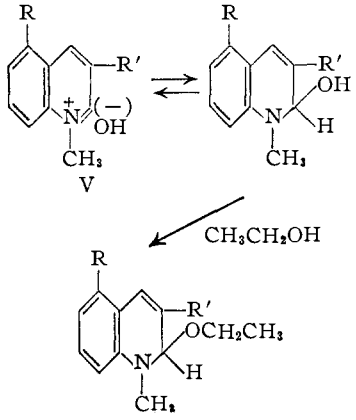
Further support for this stereochemical argument would, of course, lie in the isolation and characterization of the anilino derivative II of the α-epoxy ketone, since by its formation one could demonstrate the interaction possible between the *cis*-$CH_2NHC_6H_5$ and COC_6H_5 groups *in a molecule where the epoxide ring was intact*, as



Such a compound would be expected to take part in typical carbinol-amine–ketone tautomerism recognizable by characteristic effects in the infrared. For example, due to the interaction of the secondary amino and the carbonyl groupings, this compound would not be expected to show the typical ketone absorption at 5.88 μ characteristic of the aniline derivative III.

We are now reporting the characterization of the 3,4-epoxypyrrolidine derivative, isolated in the form of its stable ethyl ether II, R = C_2H_5. This compound was mentioned previously[2] as an unidentified product in the reaction of α-diphenacyl chloride with aniline–water mixtures, followed by a work-up in ethyl alcohol. The proof of structure is based on the following evidence: (a) elementary analysis corresponds to a compound $C_{24}H_{23}O_2N$; (b) the infrared spectrum shows no characteristic OH, NH or carbonyl absorption; (c) active hydrogen determination is negative; (d) alkoxyl analysis shows one ethoxyl group; (e) treatment with aqueous HCl readily converts this product into the hydroxy pyrrole IV, Y = OH. Isolation and characterization of II strongly supports the configurational assignments previously made.[2,3]

The ready transformation of an unstable carbinolamine such as II, R = H, to the corresponding ether, in the presence of an alcohol, has many analogies, as in the conversion of the quinolinium hydroxide (V) to the corresponding ether merely by recrystallization from ethanol.[4,5] The 6-ox-3-azabicyclo(3.1.0)hexane ring system corresponding to II, which presumably occurs in the natural product, scopolamine, appears not to have been previously prepared synthetically. This fused ring system was thought to be formed in the reactions of 1,3-butadiene derivatives with nitrosobenzene,[6] but the latter reaction products now appear to be phenyl-substituted dihydroöxazine derivatives.[7]



We wish to thank N. L. Wendler for helpful discussion of this problem.

Experimental

The Action of Aniline on α-Diphenacyl Chloride in the Presence of Water.—A mixture of 3 g. of α-diphenacyl chloride (m.p. 116–118°), 7.5 g. of aniline and 60 cc. of water was stirred and heated at the reflux temperature for 3 hours. The resulting red oily layer was separated from the aqueous layer, the oil was cooled and then triturated with dilute acetic acid to yield 2.7 g. of solid. Recrystallization from ethanol gave 1.8 g. (60%) of starting material, m.p. 116.5–118°, identified by its infrared spectrum. From the ethanol filtrate was obtained 300 mg. of a substance, m.p. 116–121°. Two recrystallizations from chloroform–ethanol raised the melting point to 126–128°. The infrared spectrum of this compound showed no bands corresponding to OH, NH or carbonyl groups. A Zerewitinoff determination on this product showed no active hydrogen. Treatment with dilute hydrochloric or acetic acid converted this product to a compound the infrared spectrum of which identified it as 3-hydroxy-1,2,4-triphenylpyrrole.[2,8]

Anal. Calcd. for $C_{24}H_{23}O_2N$: C, 80.64; H, 6.49; N, 4.33; OCH_2CH_3, 12.89. Found: C, 80.34; H, 6.12; N, 4.23; OCH_2CH_3, 13.29.

(4) N. Sidgwick, "The Organic Chemistry of Nitrogen," Clarendon Press, Oxford, 1945, p. 525.
(5) H. Decker, *J. prakt. Chem.*, [2] **45**, 182 (1892).
(6) O. Wichterle, *Collection Czech. Chem. Communs.*, **12**, 292 (1947).
(7) O. Wichterle, *ibid.*, **16**, 33 (1951).
(8) O. Widman, *Ann.*, **400**, 86 (1913).

DEPARTMENT OF CHEMISTRY
YALE UNIVERSITY
NEW HAVEN, CONN.

Methyl 2-*O*-Methyl-α-D-glucopyranoside and its Triacetate

BY ROY L. WHISTLER AND STANLEY J. KAZENIAC

RECEIVED AUGUST 23, 1954

In a recent Note[1] a preparation was described which was thought to lead to the production of methyl 4-*O*-methyl-α-D-glucopyranoside and its triacetate. In the preparation methyl 2,3-di-*O*-acetyl-6-*O*-trityl-α-D-glucopyranoside was methylated with silver oxide and methyl iodide. The product is methyl 3,4-di-*O*-acetyl-2-*O*-methyl-6-*O*-trityl-α-D-glucopyranoside instead of the 4-*O*-methyl product as previously stated. The alkalinity of the silver oxide reagent is sufficient to bring about a shift of acetyl groups such that the hydroxyl on carbon atom C-4 is quickly blocked and the hydroxyl on carbon atom C-2 opened. A similar acetyl migration was obtained by Haworth,

(1) R. L. Whistler and S. J. Kazeniac, THIS JOURNAL, **76**, 3044 (1954)

Hirst and Teece[2] when methyl 2,3,4-tri-*O*-acetyl-α-D-glucopyranoside was methylated with the Purdie reagent. In that instance the acetyl migrated to give the 3,4,6-tri-*O*-acetyl derivative and methylation took place at carbon atom C-2. Thus the present reaction is another illustration that acetyl groups cannot be used to block particular hydroxyl groups in a sugar derivative, if the derivative is at any time subject to mild alkaline treatment.

Proof that the methyl ether group is at carbon atom C-2 was established through the 2-*O*-methyl-D-glucophenylhydrazone derivative, the D-glucophenylosazone derivative, and the strong dextrorotary shift of the methyl mono-*O*-methyl-α-D-glucopyranoside in cuprammonium solution.[3] The latter property is characteristic and readily distinguishes the methyl 2-*O*-methyl derivative from the methyl 4-*O*-methyl-α-D-glucopyranoside which exhibits a strong levorotatory shift in cuprammonium.[4]

Experimental

2-*O*-Methyl-D-glucophenylhydrazone.—Methyl mono-*O*-methyl-α-D-glucopyranoside (1 g.), prepared as previously described,[1] was hydrolyzed with 7% aqueous hydrochloric acid (100 ml.) to constant rotation. The solution was then neutralized with Amberlite ion exchange resin IR 4B. Evaporation under vacuum of the filtrate yielded a crystalline product which on recrystallization from methanol gave pure 2-*O*-methyl-D-glucose, m.p. 157°. Treatment of this 2-*O*-methyl-D-glucose (0.5 g.) in methanol (1 ml.) with phenylhydrazine (1 ml.) and a few drops of glacial acetic acid at room temperature for 24 hours yielded the phenylhydrazone,[5] m.p. 175–176°.

Anal. Calcd. for $C_{13}H_{20}O_5N_2$: OMe, 10.9; N, 9.86. Found: OMe, 11.0; N, 10.08.

D-Glucophenylosazone.—A second sample (0.2 g.) of 2-*O*-methyl-D-glucose was heated on the steam-bath for 30 minutes with a solution containing phenylhydrazine hydrochloride (0.2 g.), sodium acetate (0.3 g.) and water (2 ml.). Recrystallization of the crude product from ethanol–water gave D-glucophenylosazone, m.p. 204°. Mixed melting point with authentic D-glucophenylosazone gave no depression. The X-ray pattern of this specimen was also identical with authentic D-glucophenylosazone.

Anal. Calcd. for $C_{18}H_{22}O_4N_4$: OMe, nil; N, 15.64. Found: OMe, nil; N, 15.54.

Optical Rotation of the Methyl Mono-*O*-methyl-α-D-glucopyranoside in Cuprammonium Solution.—The rotational shift of the methyl mono-*O*-methyl derivative in cuprammonium[4] was determined by Dr. R. E. Reeves and found to be +2080°; $[\alpha]^{25}_{436}$ +1300 ± 20° (*c* 0.7, in cuprammonium); $[\alpha]^{25}_{436}$ +300 ± 5° (*c* 0.83, in water).

(2) W. N. Haworth, E. L. Hirst and E. G. Teece, *J. Chem. Soc.*, 2858 (1931).
(3) R. E. Reeves, *Advances in Carbohydrate Chem.*, **6**, 107 (1951).
(4) R. E. Reeves, THIS JOURNAL, **71**, 215 (1949).
(5) P. Brigl and R. Schinle, *Ber.*, **62**, 1716 (1929).

DEPARTMENT OF BIOCHEMISTRY
PURDUE UNIVERSITY
LAFAYETTE, IND.

5-Hydroxy-5-hydroperoxybarbituric Acid ("Alloxan Hydroperoxide") and Other Alloxan Adducts[1]

BY BERNHARD WITKOP, SIDNEY GOODWIN AND THEODORE W. BEILER

RECEIVED APRIL 5, 1954

It has been shown in the preceding paper that the yellow solution of dimethyl diketosuccinate in absolute ether is readily decolorized by the addition of one mole of ethereal hydrogen peroxide with the formation of a very labile hydroperoxide, presumably dimethyl α-keto-α′-hydroperoxysuccinate. We have now applied this reaction to anhydrous alloxan (I), a lemon-yellow compound, easily obtained by vacuum sublimation of its hydrate (III).[2] The colorless hydroperoxide obtained in this way had the composition $C_4H_2N_2O_4 \cdot H_2O_2$ (or less likely the dimeric structure) and differed from the ill-defined compound $(C_4H_2N_2O_4)_{10} \cdot H_2O_2$ isolated by Stoltzenberg[3] as the product resulting from the reaction of 30% hydrogen peroxide on an aqueous solution of alloxan. The infrared spectra of alloxan hydrate[4] and of the hydrogen peroxide adduct were similar. The hydrogen peroxide adduct may exist in the chelate from II (OOH at 2.95 instead of 2.85).

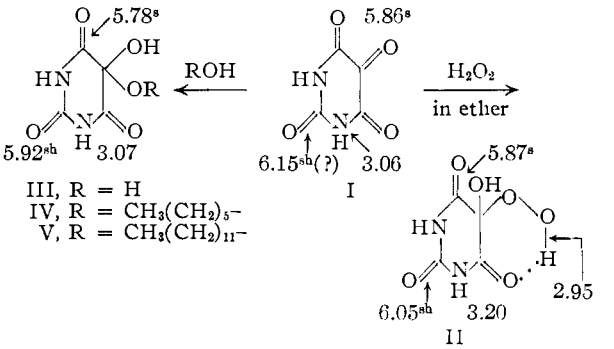
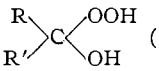


Table I shows that the polarographic reduction waves of the hydrate and hydroperoxide of alloxan at *p*H 6 do not differ appreciably from a mixture of alloxan and hydrogen peroxide or from hydrogen peroxide alone. The exchange of alloxan hydrate with H_2O^{18} (48% after 16 hours at 25°)[5] shows the lability of the water molecule in alloxan "hydrate." By comparison, hydroxyalkylhydroperoxides of the type



(R and R′ = alkyl)

are not known, but the equivalent dimeric structures are more stable than the corresponding hydrates.[6]

TABLE I

POLAROGRAPHIC REDUCTION OF ALLOXAN ADDUCTS

The solvent was Eimer and Amend Standard Buffer Solution *p*H 6.0 at 25°. The concentration of the sample was approximately 1 mmole/l. The figures mean volts *vs.* SCE.

Compound	Wave I	Wave II	Wave III[b]
Alloxan hydrate[a]	−0.115	−0.965	−1.52
Alloxan hydroperoxide	− .120	− .950	−1.51
Equimolar mixt. of alloxan hydrate and H_2O_2	− .110	− .945	−1.55
Hydrogen peroxide	.....	− .950[c]	....

[a] *Cf.* G. Sartori and A. Liberti, *Ricerca sci.*, 16, 313 (1946); *C.A.*, **43**, 7835 (1949). [b] Wave III is a catalytic hydrogen wave. [c] Reported −0.94 [I. M. Kolthoff and C. S. Miller, THIS JOURNAL, **63**, 1013 (1941)].

(1) Oxidation Mechanisms. XIII. Preceding paper in this series, S. Goodwin and B. Witkop, THIS JOURNAL, **76**, 5599 (1954).
(2) H. Biltz, *Ber.*, **45**, 3659 (1912).
(3) H. Stoltzenberg, *ibid.*, **49**, 1545 (1916).
(4) R. S. Tipson and L. H. Cretcher, *J. Org. Chem.*, **16**, 1091 (1951).
(5) M. Senkus and W. G. Brown, *ibid.*, **2**, 569 (1938); *cf.* B. Stehlík, *Chem. Zvesti*, **3**, 325 (1949); *C. A.*, **45**, 561 (1951).
(6) *Cf.* R. Criegee in Houben-Weyl, "Methoden der Organischen Chemie," Georg Thieme Verlag, Stuttgart, 1952, Vol. VIII/III, p. 43.