mother liquors (yield 88%). The infrared spectrum[10] of the material showed no carbonyl absorption but did indicate strong NH/OH absorption. Analytical data established the product to be 3-anilino-3-phenyl-1-propanol.

A similar reduction using ether as a solvent in place of tetrahydrofuran also gave the amino alcohol, yield 64%.

Anal. Calcd. for $C_{15}H_{17}NO$: C, 79.26; H, 7.54; N, 6.15. Found: C, 79.51, 79.70; H, 7.37, 7.30; N, 6.24, 6.00.

A portion of the amino alcohol was refluxed in benzene for two hours with excess phenyl isocyanate. The benzene was distilled and the solid recrystallized from toluene. The phenylurea-phenylurethan of II melted at 166–167.5°.

Anal. Calcd. for $C_{29}H_{27}N_3O_3$: C, 74.82; H, 5.84; N, 9.02. Found: C, 74.85, 74.85; H, 5.79, 5.65; N, 9.14, 9.31.

Lithium Aluminum Hydride Reduction of β-Phenyl-β-Anilinopropionic Acid.—To a solution of 1.14 g. (0.03 mole) of lithium aluminum hydride in 150 ml. of dry ether was added 7.78 g. of β-phenyl-β-anilinopropionic acid[7] in 140 ml. of tetrahydrofuran and a vigorous exothermic reaction observed. After standing at room temperature for 18 hours the mixture was hydrolyzed with wet ether and 10% aqueous sodium hydroxide. The ether tetrahydrofuran layer was decanted, washed with water and concentrated. The oil remaining did not crystallize so it was taken into toluene, washed with alkali to remove unreduced acid, dried, concentrated to a small volume and cooled. The crystals which separated were recrystallized from toluene and melted at 87–88°. The melting point of this product when mixed with the material from the lactam reduction was not depressed.

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[10] We wish to thank Dr. J. L. Johnson and associates of the Upjohn Department of Physics for the infrared data and Mr. W. A. Struck and associates of the Upjohn Analytical Chemistry Laboratory for the analytical data.

THE RESEARCH LABORATORIES
THE UPJOHN COMPANY AND THE
DEPARTMENT OF CHEMISTRY
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The Preparation of Crystalline *dl*-Pantothenamide

BY MAYNETTE VERNSTEN, W. C. BRAATEN AND M. B. MOORE

RECEIVED MAY 29, 1954

Previous attempts in these laboratories to produce a solid form of pantothenamide led to the discovery of pantothenamide–calcium chloride double salt.[1] Although Wieland, *et al.*,[2] recently have described the synthesis of oily *d*-pantothenamide by another method, it was found here that the addition of pure β-alanine amide to *dl*-pantolactone provides a method of obtaining pure solid *dl*-pantothenamide. Optical crystallographic and X-ray diffraction characteristics proved the crystalline nature of this solid.

Experimental[3]

β-Alanine Amide.—β-Alanine amide hydrochloride (1.54 g., 0.023 mole) prepared from cyanoacetamide by the method of Carlson[4] was slurried in water with the hydroxyl form of IRA 400 resin[5] to remove the chloride ion. The resulting solution was lyophilized to yield the β-alanine amide free base which is hygroscopic and rapidly absorbs carbon dioxide from the air.

***dl*-Pantothenamide.**—β-Alanine amide (0.7 g., 0.0079 mole) and *dl*-pantolactone (1.03 g., 0.0079 mole) were mixed in a flask protected by a soda lime drying tube and then warmed in hot water until the two solids liquefied. After standing at room temperature for three days the clear colorless oil was dissolved in 50 ml. of absolute alcohol, filtered through sintered glass and dried *in vacuo* for two days at 50°. The resulting gummy residue was stirred several times with dry ether and it then crystallized, m.p. 97–100°, 1.5 g. (88%). A sample of this material was dried *in vacuo* at 56°, m.p. 106–108°.

Anal. Calcd. for $C_9H_{18}N_2O_4$: C, 49.52; H, 8.31; N, 12.83. Found: C, 49.07; H, 8.32; N, 12.99.

Acknowledgment.—The authors wish to express their appreciation to M. Freifelder for the reduction of the cyanoacetamide, to E. A. Shelberg and his staff for the microanalyses, and to the Physical Chemistry Department for the physical measurements.

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[1] M. B. Moore, U. S. Patent 2,369,839 (1945).

[2] T. Wieland, E. A. Miller and G. Dieckelmann, *Ber.*, **85**, 1035 (1952).

[3] Melting points are corrected.

[4] G. H. Carlson, U. S. Patent 2,354,909 (1944).

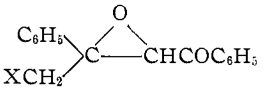
[5] Rohm and Haas Company.

cis- and *trans*-γ-Halo-α,β-epoxy Ketones. Reactions with Aniline

BY HARRY H. WASSERMAN AND JOYCE B. BROUS[1]

RECEIVED JUNE 7, 1954

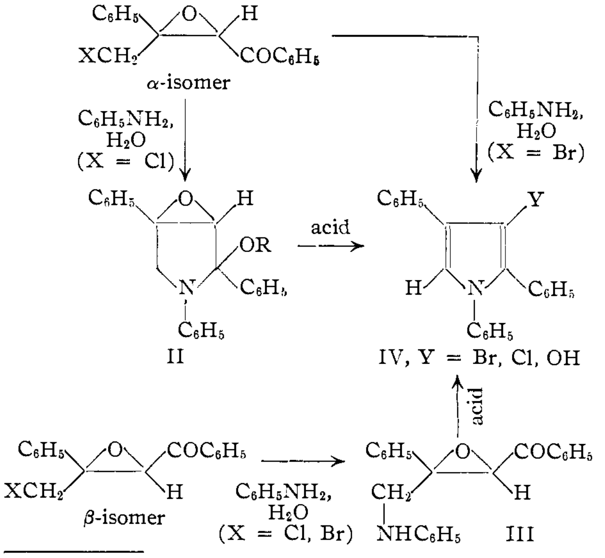
In previous articles[2,3] the reactions of various organic bases with the isomeric γ-halo-α,β-epoxy ketones of general structure I were described. Based on these reactions, conclusions were drawn with respect to the configurations of these so-called halodiphenacyls, namely, that the α-isomers have a *trans* arrangement of phenyl and benzoyl groupings and the β-isomers, the *cis* configuration.



I, X = Cl, Br

The reactions with aniline–water mixtures in the β-series, as summarized in Chart I, led only to a monoanilino derivative III, which could be converted to a pyrrole IV only by a second-stage treat-

CHART I



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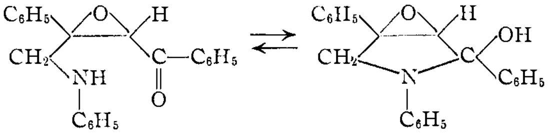
[1] Abstracted from a dissertation by J. B. Brous presented to the faculty of Yale University in partial fulfillment of the requirements for the degree of Doctor of Philosophy, 1954.

[2] H. H. Wasserman and J. B. Brous, *J. Org. Chem.*, **19**, 515 (1954).

[3] C. L. Stevens and V. J. Traynelis, *ibid.*, **19**, 533 (1954).

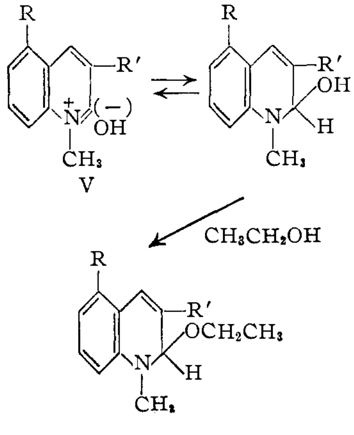
ment with HCl. On the other hand, although the α-isomers were less reactive under the same conditions, the pyrrole appeared to form *directly* when reaction did take place. The latter result was interpreted as evidence that the spacial arrangement of CH_2X (X = Cl, Br) and COC_6H_5 groupings in the α-isomers 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.

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[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).

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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,

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