Acknowledgments. The authors are indebted to Dr. Peter Lim for interpretation of the infrared spectra as well as for discussions, to O. P. Crews, Jr., and staff for large-scale preparation of intermediates, and to Dr. L. K. Moss and staff for the chromatograms and optical rotations.

MENLO PARK, CALIF.

[CONTRIBUTION FROM THE DEPARTMENT OF BIOLOGICAL SCIENCES, STANFORD RESEARCH INSTITUTE]

Potential Anticancer Agents.[1] XI. Synthesis of Nucleosides Derived from 6-Deoxy-L-idofuranose

ELMER J. REIST, ROLAND R. SPENCER, AND B. R. BAKER

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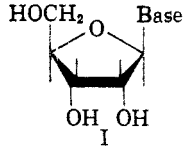
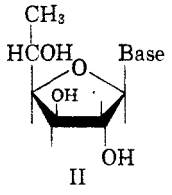
Lithium aluminum hydride reduction of 6-*O*-benzoyl-1,2-*O*-isopropylidene-5-*O*-tosyl-D-glucofuranose (IV) has led to a new and useful synthesis of 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX). The latter was converted to 9-(6′-deoxy-α-L-idofuranosyl)adenine (XV) and to 2,6-diamino-9-(6′-deoxy-α-L-idofuranosyl)purine (XIV) *via* the key intermediate 1,2-di-*O*-acetyl-3,5-di-*O*-benzoyl-6-deoxy-L-idofuranose (VII).

In a preceding paper of this series,[2] the rationale for synthesizing 6-deoxy-L-idofuranosyl nucleosides (II) was presented. This paper describes the synthesis of 9-(6′-deoxy-α-L-idofuranosyl)adenine (XV) and 2,6-diamino-9-(6′-deoxy-α-L-idofuranosyl)purine (XIV), compounds that might be antagonists of natural D-ribofuranosyl nucleosides (I).



I



II

The key intermediate in the projected synthesis of the nucleosides XIV and XV is 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX), which has been synthesized by the hydrogenation of 5,6-anhydro-3-*O*-benzyl-1,2-*O*-isopropylidene-L-idofuranose (VI)[3] and by hydrogenation of the glucosene (XII).[4] A new synthesis of this key intermediate (IX) that is considered to be shorter and more convenient has now been developed.

Ohle and Dickhauser[5] have claimed that tosylation of 6-*O*-benzoyl-1,2-*O*-isopropylidene-D-glucofuranose (III) in pyridine-chloroform at 37° for 4 days gave the 5-*O*-tosyl derivative (IV) in 34% yield, but Meyer and Reichstein[3] obtained a yield of only 20% by this procedure. It was observed in this laboratory that the infrared absorption spectrum of 6-*O*-benzoyl-1,2-*O*-isopropylidene-D-glucofuranose (III) contained the benzoate carbonyl stretching band at 5.90 μ instead of at the normal position of 5.80 μ. Tosylation of III to give the 5-*O*-tosyl derivative (IV) caused this carbonyl stretching band to shift back to the normal 5.80 μ position, presumably because the 5-tosylate destroyed hydrogen bonding between an available hydroxyl and the 6-benzoate carbonyl of III. This shift in the position of the carbonyl band made it possible to determine the degree of completion of the reaction by the gradual disappearance of the band at 5.90 μ. Thus, the most optimum conditions found involved the use of pyridine–methylene chloride at 40–50° for 4 days, which gave IV in 43% yield; a shorter reaction time, a lower temperature, or chloroform as a solvent[5] gave less complete conversion.

Meyer and Reichstein[3] have converted the 5-tosyl derivative (IV) with methanolic sodium methoxide to 5,6-anhydro-1,2-*O*-isopropylidene-L-idofuranose (V) in 61% yield. In this laboratory, their procedure gave a 64% yield of partially crystalline product (V) that was difficult to purify since it readily decomposed. It has now been found that lithium aluminum hydride reduction of the tosylate (IV) gave a 78% yield of the desired 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX), the reaction presumably proceeding *via* the anhydro L-idose derivative (V). The 6-deoxy-L-idose derivative (IX) agreed in melting point (90–92°) with that given by Meyer and Reichstein[3,4] and gave a large depression in melting point when mixed with the isomeric 6-deoxy-1,2-*O*-isopropylidene-D-glucofuranose,[2] a possible, though theoretically unlikely, product.

Treatment of 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX) with benzoyl chloride in pyridine gave the dibenzoate (VIII) in quantitative yield as an oil that could not be crystallized. Acetolysis of

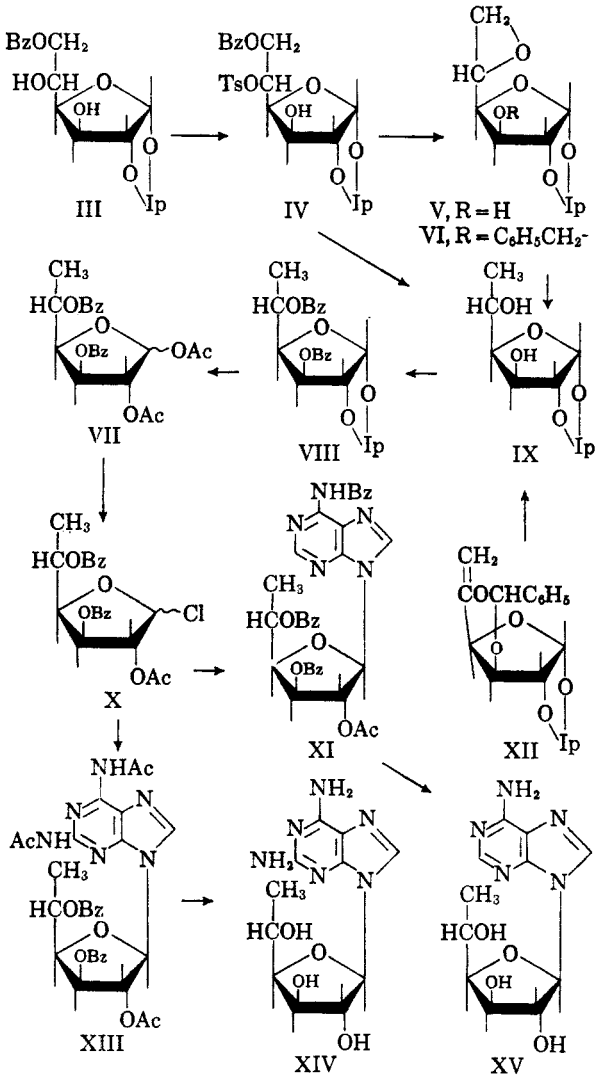
(1) This program is under the auspices of the Cancer Chemotherapy National Service Center, National Cancer Institute, and is in collaboration with the Sloan-Kettering Institute for Cancer Research.

(2) E. J. Reist, R. R. Spencer, and B. R. Baker, Paper X of this series, *J. Org. Chem.*, **23**, 1753 (1958).

(3) A. S. Meyer and T. Reichstein, *Helv. Chim. Acta*, **29**, 152 (1946).

(4) A. S. Meyer and T. Reichstein, *Helv. Chim. Acta*, **29**, 139 (1946).

(5) H. Ohle and E. Dickhauser, *Ber.*, **58B**, 2593 (1925).



VIII with acetic acid, acetic anhydride, and sulfuric acid gave a 72% yield of an anomeric mixture of diacetates (VII) that also failed to crystallize. However, crystalline nucleosides (XIV and XV) were obtained by the standard coupling procedure.[6,7]

Conversion of the diacetate (VII) to the chloro sugar (X) with ethereal hydrogen chloride[8] containing acetyl chloride,[9] followed by coupling with chloromercuri-6-benzamidopurine, gave the crude blocked nucleoside (XI). Deacylation of XI with methanolic sodium methoxide afforded a 15% yield (based on VII) of crystalline 9-(6′-deoxy-α-L-idofuranosyl)adenine (XV),[10] isolated *via* its picrate and regenerated with Dowex 2 (CO_3).[6,11] This nucleoside, when chromatographed on paper,[12] gave a single spot with R_{Ad} 1.44 in solvent A and R_{Ad} 0.76 in solvent B.

Similarly, condensation of X with chloromercuri-2,6-diacetamidopurine followed by deacylation gave a 6.5% yield (based on VII) of crystalline 2,6-diamino-9-(6′-deoxy-α-L-idofuranosyl)-purine (XIV).[10] This nucleoside, when chromatographed on paper,[12] also gave a single spot with R_{Ad} 0.88 in solvent A and R_{Ad} 0.36 in solvent B.

EXPERIMENTAL[12,13]

6-O-Benzoyl-1,2-O-isopropylidene-D-glucofuranose (III). A solution of 4.41 g. (12 mmoles) of 3-*O*-benzoyl-1,2:5,6-di-*O*-isopropylidene-D-glucofuranose[15] in 20 ml. of 60% ethanol was adjusted to *p*H 2 with 6*N* hydrochloric acid, then heated at 50° for 4.5 hr. At the end of this time a 5-ml. aliquot was removed and extracted with chloroform (3 × 10 ml.). The combined extracts, dried with magnesium sulfate and evaporated to dryness *in vacuo*, left 0.71 g. of 3-*O*-benzoyl-1,2-*O*-isopropylidene-D-glucofuranose: λ_{max}^{film} 2.90 μ (OH), 5.80 μ (C=O), 7.87 μ (benzoate C—O—C). This material consumed 0.64 mole-equivalents of periodate in 1 hr.

The remaining 15 ml. of hydrolysis solution was carefully adjusted to *p*H 8 with 2*N* potassium hydroxide, then allowed to stand at about 3° overnight. The 6-benzoate (III) was collected on a filter and washed with cold 60% ethanol; yield, 2.56 g. (87%), m.p. 182–184°. Recrystallization from 60% ethanol gave 1.70 g. (58%) of white crystals, m.p. 193–195°, $[\alpha]_D^{25}$ +6.0° ± 2.5° (0.5% in ethanol); λ_{max}^{KBr} 2.85 μ (OH), 5.92 μ (benzoate C=O), 7.25 μ (CH_3), 7.77 μ (benzoate C—O—C). This compound did not react with periodate.

Ohle[16] has recorded a melting point of 191–192° and a rotation of +7.4° in ethanol for this product. The above periodate data give unambiguous support to Ohle's hypothesis that acid removes the 5,6-*O*-isopropylidene group only and that base isomerizes the 3-benzoate to the 6-benzoate. The *p*H 2 and *p*H 8 required for the two steps are quite critical to avoid over- or under-hydrolysis of groups.

(5) E. J. Reist, L. Goodman, R. R. Spencer, and B. R. Baker, Paper IV of this series, *J. Am. Chem. Soc.*, 80, 3962 (1958).

(7) B. R. Baker and K. Hewson, *J. Org. Chem.*, 22, 966 (1957).

(8) J. Davoll, B. Lythgoe, and A. R. Todd, *J. Chem. Soc.*, 967 (1948).

(9) B. R. Baker and R. E. Schaub, *J. Am. Chem. Soc.*, 77, 5900 (1955).

(10) That this nucleoside has the α-configuration is reasonably certain since formation of nucleosides by this process normally gives a product with a C_1-C_2-*trans*-configuration in the sugar moiety. For a summary of reactions illustrating this point *cf.* B. R. Baker on Stereochemistry of Nucleoside Synthesis, Ciba Foundation Symposium on the Chemistry and Biology of Purines, J. and A. Churchill, Ltd., London, 1957, pp. 120.

(11) B. R. Baker and K. Hewson, *J. Org. Chem.*, 22, 959 (1957).

(12) Paper chromatograms of the nucleosides were run on Whatman No. 1 paper by the descending technique in 5% disodium phosphate (solvent A) and in water-saturated butanol (solvent B). The spots were located by visual examination with an ultraviolet lamp. Adenine was used as a standard and was arbitrarily assigned a value of R_{AD} 1.00.

(13) Melting points were taken on a Fisher-Johns apparatus and are uncorrected. Optical rotations were determined with a Standard Polarimeter Model D attachment to the Beckman DU spectrophotometer calibrated with standard sucrose solutions.[14]

(14) A. S. Keston, Abstracts of 127th Meeting, American Chemical Society 18C (1955).

(15) E. Fischer and H. Noth, *Ber.*, 51, 321 (1918).

(16) H. Ohle, *Biochem. Z.*, 131, 611 (1912); *Ber.*, 57B, 403 (1924).

6-O-Benzoyl-1,2-O-isopropylidene-5-O-tosyl-D-glucofuranose (IV). To a stirred solution of 11.9 g. (30.8 mmoles) of III in 79 ml. of reagent pyridine was added dropwise a solution of 6.95 g. (36.6 mmoles) of tosyl chloride in 190 ml. of methylene chloride over a period of 45 min. The solution was kept at 40–50° for 4 days protected from moisture, then poured into 500 ml. of ice water with stirring. The separated aqueous phase was extracted with chloroform (3 × 50 ml.). The organic extracts were washed with 50 ml. of saturated aqueous sodium bicarbonate and 50 ml. of water, then combined. Dried with magnesium sulfate, the organic solution was evaporated to dryness *in vacuo*. The last traces of pyridine were removed by the addition and removal of toluene (2 × 10 ml.) *in vacuo*. The gummy solid (16.2 g.) showed a benzoate band at 5.80 μ with a small shoulder at 5.90 μ, thus indicating that tosylation was essentially complete. Recrystallization from ethanol gave 7.52 g. (43%) of product, m.p. 138–140°, $[\alpha]_D^{25}$ +20.6° ± 1.4° (2.0% in $CHCl_3$);[17] λ_{max}^{KBr} 2.90 μ (OH), 5.80 μ (benzoate C=O), 7.85 μ (benzoate C—O—C), 8.50 μ (sulfonate).

Anal. Calcd. for $C_{23}H_{26}O_9S$: C, 57.7; H, 5.48; S, 6.70. Found: C, 58.0; H, 5.60; S, 6.55.

Ohle and Dickhauser[5] have recorded m.p. 142°, $[\alpha]_D^{27}$ +9.34° (2.142% in $CHCl_3$), and a yield of 34%, whereas Meyer and Reichstein[3] obtained a 20% yield by their procedure.[5]

6-Deoxy-1,2-O-isopropylidene-L-idofuranose (IX). To a mixture of 4.74 g. (0.12 mole) of lithium aluminum hydride and 300 ml. of reagent ether was added 25.0 g. (0.052 mole) of pure IV over a period of about 45 min. The mixture, protected from moisture, was refluxed with stirring for 20 hr., then the excess hydride was decomposed by the dropwise addition of 25 ml. of ethyl acetate, then 12 ml. of water. After 36 ml. of 10% aqueous sodium hydroxide was added, Celite was added to make a filterable slurry. The mixture was filtered and the filter cake was washed with chloroform (3 × 20 ml.). The filtrate and washings were combined, dried with magnesium sulfate, and evaporated to dryness *in vacuo* at 20 mm. and finally at 0.5 mm. to give 3.14 g. (30%) of a light yellow sirup that crystallized overnight. The Celite cake was placed in a Soxhlet extractor and extracted for 4 hr. with chloroform, giving an additional 5.19 g. (48%) of product; λ_{max}^{KBr} 2.95 μ (OH), 7.26 μ (CH_3), 9.25, 9.58, 9.85 μ (C—O—C, C—OH). A total yield of 8.33 g. (78%) was thus obtained that was suitable for the next step.

A sample of 0.72 g. was distilled at 3 μ (b.p. 90–95°), giving 0.51 g. of a clear sirup that crystallized overnight, m.p. 90–92°, $[\alpha]_D^{25}$ −7.1 ± 1.9° (2.2% in $CHCl_3$). A mixture with 6-deoxy-1,2-*O*-isopropylidene-D-glucofuranose melted at 65–70°.

Meyer and Reichstein[3,4] have recorded m.p. of 90–91° and $[\alpha]_D^{21}$ −12.9 ± 0.6° (3.6% in $CHCl_3$) for this compound prepared in other ways.

3,5-Di-O-benzoyl-6-deoxy-1,2-O-isopropylidene-L-idofuranose (VIII). To a solution of 5.17 g. (25.6 mmoles) of crude 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX) in 50 ml. of reagent pyridine, cooled to 0°, 9.3 ml. (81 mmoles) of benzoyl chloride was added dropwise with stirring, the temperature being maintained below 5°. After being stirred for an additional hour at 0°, the mixture was left at room temperature for 24 hr., protected from moisture. The reaction mixture was then added dropwise to a well-stirred mixture of ice and excess saturated aqueous sodium bicarbonate solution. The organic layer was separated and the aqueous layer was extracted with three 50-ml. portions of chloroform. The organic layer and separate extracts, washed with excess saturated aqueous sodium bicarbonate, then water, were combined and dried with magnesium sulfate and evaporated *in vacuo*. The last traces of pyridine were removed by the addition of two 20-ml. portions of toluene and removal *in vacuo* to give 11.1 g. (108%) of dark sirup which contained benzoic anhydride; λ_{max}^{film} 5.60 μ (anhydride C=O), 5.82 μ (benzoate C=O), 7.25 μ (CH_3), 7.88, 9.01 μ (benzoate C—O—C), 9.10, 9.33, 9.75 μ (C—O—C). This material was suitable for the next step.

In a pilot run, 0.20 g. (0.93 mmoles) of pure 6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (IX) gave a product free of benzoic anhydride; yield, 0.30 g. (60%), $[\alpha]_D^{30}$ −12.3° (0.5% in $CHCl_3$).

Anal. Calcd. for $C_{23}H_{24}O_7$: C, 67.0; H, 5.87. Found: C, 66.9; H, 6.09.

1,2-Di-O-acetyl-3,5-di-O-benzoyl-6-deoxy-L-idofuranose (VII). To a solution of 9.14 g. (22.2 mmoles) of crude 3,5-di-*O*-benzoyl-6-deoxy-1,2-*O*-isopropylidene-L-idofuranose (VIII) in 100 ml. of glacial acetic acid and 12.2 ml. of acetic anhydride was added 7.6 ml. of 96% sulfuric acid dropwise with stirring, the temperature being maintained below 20°. After standing at room temperature overnight while protected from moisture, the mixture was poured into 300 ml. of ice water and stirred for 30 min. The organic layer was separated and the aqueous layer was extracted twice with 50-ml. portions of chloroform. The organic layer and separate extracts were washed with water, excess aqueous sodium bicarbonate solution, and water, then combined, dried over magnesium sulfate, and evaporated *in vacuo* to yield 7.13 g. (69%) of a dark yellow sirup which did not crystallize so could not be obtained analytically pure; λ_{max}^{film} 5.70 μ (acetate C=O), 5.80 μ (benzoate C=O), 7.27 μ (CH_3), 7.88, 9.00 μ (benzoate C—O—C), 8.10, 8.22 μ (acetate C—O—C), 9.10, 9.33, 9.72 μ (C—O—C); $[\alpha]_D^{27}$ +35.5 (3.4% in $CHCl_3$).

Anal. Calcd. for $C_{24}H_{24}O_9$: C, 63.1; H, 5.30. Found: C, 64.7; H, 5.48.

9-(2′-O-Acetyl-3′,5′-di-O-benzoyl-6′-deoxy-α-L-idofuranosyl)-6-benzamidopurine (XI). A solution of 2.30 g. (5.0 mmoles) of VII in 5 ml. of acetyl chloride was added to 60 ml. of reagent ether that had been previously saturated with hydrogen chloride at 0°. After standing at −5° for 3 days in a stoppered container, the mixture was evaporated to dryness *in vacuo* with protection from moisture. Acetic acid was removed by the addition of benzene (2 × 10 ml.) and evaporation *in vacuo*. The pale yellow sirup (X) was dissolved in xylene and condensed with 2.87 g. of chloromercuri-6-benzamidopurine[18] in the usual manner.[6,7] Evaporation of the chloroform solution gave 2.46 g. of crude XI as an amber colored glass: λ_{max}^{film} 3.00 μ (NH), 5.71 μ (acetate C=O), 5.78 μ (benzoate C=O), 6.22, 6.31, 6.60, 6.68 μ (NH and aromatic rings), 7.82, 9.00 μ (benzoate C—O—C), 8.10 μ (acetate C—O—C), 9.10, 9.34, 9.72 μ (C—O—C).

9-(6′-Deoxy-α-L-idofuranosyl)adenine (XV). A solution of 2.46 g. of crude XI in 30 ml. of reagent methanol and 6 ml. of *N* methanolic sodium methoxide was refluxed for 1.5 hr. The solution was neutralized with acetic acid, then evaporated to dryness *in vacuo*. The residue was partitioned between 10 ml. of water and 10 ml. of chloroform. The aqueous layer was washed with chloroform, then evaporated to dryness *in vacuo*. A solution of the residue in 15 ml. of reagent methanol was treated with 20 ml. of 10% methanolic picric acid. After several hours at 0°, the mixture was filtered and the precipitate was washed with methanol. Recrystallization from 25 ml. of water gave 0.60 g. of the picrate of XV as yellow crystals, m.p. 200–220° (dec.). The free nucleoside was regenerated from the picrate with 2.5 g. of Dowex 2 (CO_3) and 20 ml. of water in the usual fashion.[6,11] Evaporation of the aqueous solution to dryness *in vacuo* gave 0.21 g. (15%), m.p. 205–210°. Recrystallization from ethanol afforded white crystals, m.p. 196–198°; λ_{max}^{KBr} 2.98, 3.09 μ (NH, OH), 6.07, 6.22, 6.33, 6.75 μ (NH and aromatic ring), 7.25 μ (CH_3), 9.07, 9.23, 9.46, 9.87 μ (C—O). The

(17) This value has been checked several times but it does not agree with the value reported by Ohle and Dickhauser.[5]

(18) Prepared from mercuric chloride and 6-benzamidopurine as described for chloromercuri-2,6-diacetamidopurine.[11]

crude material contained a trace of adenine which was readily removed by the one recrystallization. The nucleoside was then chromatographically homogeneous and travelled at R_{Ad} 1.44 in solvent A and R_{Ad} 0.76 in solvent B[12]; $[\alpha]_D^{28}$ −36.9° (0.4% in H_2O).

Anal. Calcd. for $C_{11}H_{15}N_5O_4$: C, 47.0; H, 5.38; N, 24.9. Found: C, 46.7; H, 5.35; N, 24.8.

The nucleoside, in agreement with structure XV, consumed 0.78 mole-equivalent of periodate in 66 hr. The rate curve was then approaching about 0.85 mole-equivalent asymptotically.

2,6-Diacetamido-9-(2′-O-acetyl-3′,5′-di-O-benzoyl-6′-deoxy-α-L-idofuranosyl)purine (XIII). Condensation of X, prepared from 2.50 g. (5.5 mmoles) of diacetate (VII), with 2.20 g. (4.69 mmoles) of chloromercuri-2,6-diacetamidopurine[11] as described for XI gave 2.47 g. (72%) of crude blocked nucleoside; λ_{max}^{film} 3.00, 3.10 μ (NH), 5.78 μ (ester C=O), 6.14, 6.22, 6.68, 6.85 μ (NH and aromatic rings), 7.80, 8.98 μ (benzoate C—O—C), 8.09 μ (acetate C—O—C), 9.10, 9.32, 9.72 μ (C—O—C).

2,6-Diamino-9-(6′-deoxy-α-L-idofuranosyl)purine (XIV). A solution of 2.47 g. (3.90 mmoles) of XIII in 20 ml. of reagent methanol was treated with 5 ml. of *N* methanolic sodium methoxide and heated at reflux for 3 hr. The solution was then processed to the picrate as described for XV. Recrystallization from 20 ml. of water gave 248 mg. of the picrate of XIV as yellow crystals, m.p. 195–205° (dec.). Regeneration to the free nucleoside with 2.0 g. of Dowex 2 (CO_3) and 10 ml. of water in the usual fashion[6,11] gave 102 mg. (6.5%) of a white solid, m.p. 184–190°. Recrystallization from ethanol afforded white crystals, m.p. 210–211°; λ_{max}^{KBr} 2.92, 3.08 μ (NH, OH), 6.10, 6.23, 6.60, 6.75 μ (NH and aromatic rings), 9.22, 9.42 μ (C—O); $[\alpha]_D^{27}$ −50.8° (1.0% in H_2O). Both the crude and recrystallized products were chromatographically homogeneous and travelled at R_{Ad} 0.88 in solvent A and R_{Ad} 0.36 in solvent B as compared with R_{Ad} 0.54 and R_{Ad} 0.39, respectively, for 2,6-diaminopurine.

Anal. Calcd. for $C_{11}H_{16}N_6O_4 \cdot {}^1/_2H_2O$: C, 43.2; H, 5.58; N, 27.5. Found: C, 43.2; H, 5.88; N, 27.6.

Acknowledgments. The authors owe thanks to Dr. Peter Lim for interpretation of the infrared spectra, to O. P. Crews, Jr., and group for large-scale preparation of intermediates, and to Dr. L. K. Moss and group for the chromatography, periodate data, and optical rotations.

MENLO PARK, CALIF.

[CONTRIBUTION OF THE FULMER CHEMICAL LABORATORY, THE STATE COLLEGE OF WASHINGTON]

Schiff Bases and Related Substances. IV. Reaction of Acyclic and Heterocyclic α-Amino Sulfides with Phenyl Isocyanate. Comparative Reactions with Phenyl Isothiocyanate[1]

GARDNER W. STACY, PHILIP A. CRAIG,[2] AND RICHARD I. DAY[3]

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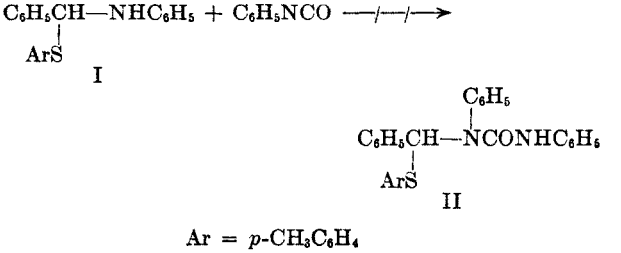
When the Schiff base–thiol adduct, *N*-[α-(*p*-tolylthio)benzyl]aniline (I), is treated with phenyl isocyanate, none of the expected phenylurea derivative is obtained. Instead, the mercaptal, α,α-bis(*p*-tolylthio)toluene (III), *N*-benzylideneaniline (IV), carbanilide (V), and *p*-tolyl phenylthiolcarbamate (VI) are isolated from the reaction mixture. On the other hand, the adduct I fails to react with phenyl isothiocyanate under similar conditions. A possible explanation for the formation of the products III–VI is suggested. Related cyclic systems containing the S—C—NH group are shown to react with phenyl isocyanate to form phenylurea derivatives and none of the unusual behavior associated with the adduct I is observed. Phenyl isothiocyanate also reacts with most of the cyclic systems which were studied (the products in these cases are the corresponding phenylthiourea derivatives). However, in the case of 2,2-pentamethylenebenzothiazoline (XII), no reaction occurs with phenyl isothiocyanate under a variety of conditions, thus paralleling the result with I.

The reaction of the Schiff base–thiol adduct, *N*-[α-(*p*-tolylthio)benzyl]aniline (I), with acetylating agents has been shown to proceed only in part to give the expected acetyl derivative.[1] To a greater extent, cleavage of I occurred to yield acetanilide and the corresponding mercaptal III or *p*-tolyl disulfide. The behavior of I with phenyl isocyanate and phenyl isothiocyanate, respectively now has also been investigated and is reported in the present paper.

Unlike the acetylation reaction,[1] none of the corresponding *N*-acyl derivative (in this case the phenylurea derivative II) was isolated when I was heated with phenyl isocyanate; instead, a cleavage reaction occurred extensively to form the mercaptal



(1) Presented in part before the Oregon Section of the American Chemical Society, Salem, Ore., May 21, 1955, and in part before the Division of Organic Chemistry at the 132nd Meeting of the American Chemical Society, New York, N. Y., Sept. 10, 1957. Paper III. G. W. Stacy, R. I. Day, and R. J. Morath, *J. Am. Chem. Soc.*, **80**, 3475 (1958).

(2) To be presented in part as a thesis by Philip A. Craig in partial fulfillment of the requirements for the Degree of Master of Science, the State College of Washington.

(3) In part abstracted from a thesis submitted by Richard I. Day in partial fulfillment of the requirements for the degree of Doctor of Philosophy, the State College of Washington, June 1957.