and 0.15 (system 3). UV spectrum, λ_{max}: 258 (pH 1) and 262 nm (pH 13). Found: C 55.8; H 5.6; N 39.3%. $C_{10}H_{12}N_6$. Calculated: C 55.5; H 5.6; N 38.9%.

8-Bromo-9-(β-carboxyethyl)adenine (III). A 0.21-g (0.001 mole) sample of 9-(β-carboxylethyl)adenine was dissolved by heating in 20 ml of 0.5 M acetate buffer, and the solution was cooled to 20°C and treated with stirring with a solution of 0.3 ml of bromine in 30 ml of water. The precipitate was removed by filtration and recrystallized from dilute ammonium hydroxide to give 0.15 g (52%) of a product with mp >350°C and R_f 0.58 (system 1), 0.68 (system 2), and 0.83 (system 3). UV spectrum, λ_{max}: 264 (pH 1) and 268 nm (pH 13). PMR spectrum: 8.12 (1H, s, 2-H), 7.38 (2H, s, 6-NH_2), 4.32 (2H, t, CH_2), and 2.81 ppm (2H, t, CH_2). Found: C 33.9; H 3.0; N 24.7%. $C_8H_8BrN_5O_2$. Calculated: C 33.6; H 2.8; N 24.5%.

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SYNTHESIS OF BIFUNCTIONALLY MODIFIED HEXOFURANOSIDES OF THYMINE AND URACIL

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The glycosylation of bis(trimethylsilyl) derivatives of uracil and thymine by bifunctionally modified derivatives of D-glucofuranose in the presence of $SnCl_4$ as the condensing agent was studied. It is shown that the β anomers of D-glucofuranose derivatives with a 1,2-trans orientation of the OAc groups undergo condensation more readily than the α anomers. Both anomers give a mixture of α and β nucleosides with significant preponderance of the latter due to the primary formation of a 1,2-acetoxonium ion. It is assumed that the formation of α nucleosides is due to the competitive coparticipation of other groups and/or more remote acetyl groups.

It has been previously shown that the introduction of a reactive functional group (a halogen atom [1, 2] or a p-tolylsulfonyl group [3]) in the carbohydrate fragment of a nucleoside molecule opens up great possibilities for the preparation of diverse modified nucleosides. In the present research we studied the glycosylation of bis(trimethylsilyl) derivatives of uracil (Ia) and thymine (Ib) by means of bifunctionally modified D-glucofuranose derivatives in the presence of $SnCl_4$ as the condensing agent.

We selected 5-O-acetyl-6-chloro-6-deoxy-1,2-O-isopropylidene-3-O-(p-tolylsulfonyl)-α-D-glucofuranose (II) [4] as a readily accessible bifunctionally modified carbohydrate component. Azide IIIa was obtained in 66% yield by treatment of II with sodium azide in anhydrous dimethylformamide (DMF) at 100°C for 35 h. According to the results of thin-layer chromato-

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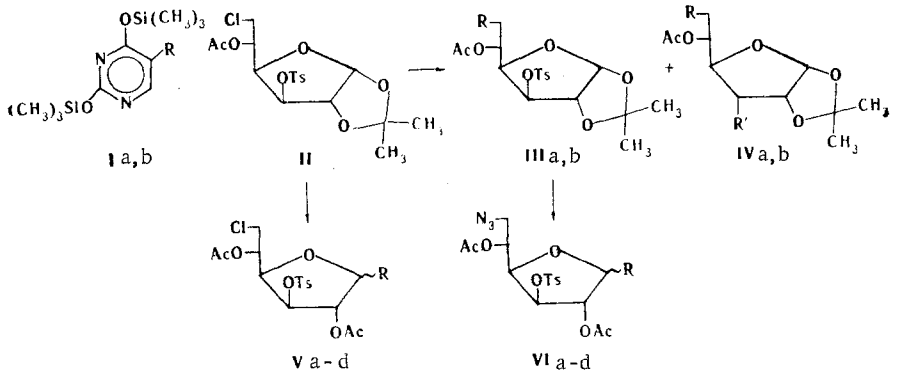
graphy (TLC), the reaction mixture contains, in addition to azide IIIa, a substance with a close R_f value (see the experimental section), which is detected by iodine vapors and does not absorb in UV light. This substance was not isolated in the individual state, and diazide structure IVa was proposed for it. When the reaction temperature was lowered to 80°C and the reaction time was increased to 130 h, azide IIIa was obtained in 51% yield. Under more severe conditions (160°C for 30 h) azide IIIa and hypothetical diazide IVa were formed in a ratio of ~1:1. In view of the close chromatographic mobilities of these compounds, we were unable to isolate them in their individual states. Successive hydrogenation (Pd/C) of azides IIIa and IVa, acetylation of the mixture of reaction products, and chromatographic separation gave mono- and diacetamido derivatives IIIb and IVb, respectively. The isolation of diacetamido derivatives IVb confirms hypothetical diazide structure IVa.

The acetolysis of chloride II ($AcOH—Ac_2O—H_2SO_4$) gave a mixture of anomeric acetates Va, b in high yield with predominance of the β anomer, according to the ^1H NMR spectroscopic data. The resonance signals of all of the carbohydrate protons of β and α anomers Va,b coincide virtually completely, except for the 1-H signal, which in the case of β anomer Va is observed in the form of a broad singlet at 5.96 ppm (compare with the data in Tables 1 and 2 for the α anomer). In one of the experiments after crystallization of the mixture of anomers we were able to isolate α anomer Vb in the individual state in 28% yield. The condensation of the mixture of β and α anomers Va, b with bis(trimethylsilyl)thymine (Ib) in dichloroethane by means of equimolar amounts of $SnCl_4$ [5] led to the formation of a mixture of β- and α-glycosides of thymine (Vc,d) in 90% yield based on the sugar that underwent reaction. The β anomer predominated in this mixture (>90%); however, the presence of very small amounts of the α anomer hindered crystallization of the former, and it was therefore isolated in crystalline form in 38% yield. Resonance signals at 6.25 ppm (d, J = 4.0 Hz) and 5.75 ppm, which were assigned, respectively, to the 1'-H and 2'-H protons of α anomer Vd, are present in the ^1H NMR spectrum of the mixture of α and β anomers that remained after isolation of individual β anomer Vc. The unchanged α anomer Vb was also isolated virtually completely from the reaction mixture. These data constitute evidence that primarily β anomer Va undergoes reaction in the condensation with the silyl derivative of thymine (Ib). However, the use of individual α anomer Vb in the condensation with Ib also led to the formation of a mixture of β and α anomers Vc,d (in 70% yield) with preponderance of the former (isolated in the individual state in 40% yield). However, the condensation proceeded at a considerably slower rate.

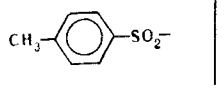
The acetolysis of azide IIIa led to the formation of a mixture of β and α anomers VIa, b, from which the individual anomers were isolated by fractional crystallization. The condensation of the mixture of β and α anomers VIa, b with the silyl derivative of uracil (Ia) in the presence of equimolar amounts of $SnCl_4$ also gave a mixture of anomeric nucleosides VIc, d, which we were able to separate into the individual components by column chromatography. Some of the starting α anomer VIb did not undergo the reaction and was also isolated from the reaction mixture in individual form by column chromatography.



Ts — p-tolysulfonyl; Thy —thymin-1-yl; Ura — uracil-1-yl; I a R=H; b R=CH_3; III a R=N_3; b R=AcNH; IV a R=R'=N_3; b R=R'=AcNH; V a R=OAc — β-anomer; b R=OAc — α-anomer; c R=Thy —β-anomer; d R=Thy —α-anomer; VI a R=OAc — β-anomer; b R=OAc — α-anomer; c R=Ura —β-anomer; d R=Ura —α-anomer

The structures of all of the compounds obtained were confirmed by ^1H NMR and IR spectroscopic data. The location of the resonance signals of the hydrogen atoms attached to C_1 ($C_{1'}$) and the magnitude of the $J_{1,2}$ spin—spin coupling constant ($J_{1',2'}$ for nucleosides) are quite informative in a number of cases in the establishment of the anomeric configuration

TABLE 1. Data from the ^1H NMR Spectra of IIIa,b, IVb, Vb,c, and VIa–d

Compound	Chemical shifts (δ, ppm) of the carbohydrate protons							Ac		Other protons
	1-H	2-H	3-H	4-H	5-H	6-H	6′-H			
IIIa	5,80 d	4,60 d	5,00 d	4,24 dd	5,94 dt	3,64 dd	3,40 dd	2,04 s	2,48 s (3H), 7,34 (2H), 7,74 d (2H)	1,30s (3H); 1,52s (3H)
IIIb	5,80 d	4,66 d	4,94 d	4,28 dd	~4,80 m	3,64 m	3,40 m	1,94 s 1,96 s	2,44 s (3H), 7,30 d (2H), 7,74 d (2H)	6,0 t (1H), NH (J=6,0 Hz); 1,28 (3H); 1,48 (3H)
IVb	5,76 d	4,68 t	5,04 m	4,00 dd	4,36 m	3,70 m	3,20 dt	2,00s 2,10s *		6,84 m (2H), NH (J_{NH, H_2} =7,0, J_{NH, H_6} = =5,0 Hz); 1,34 (3H); 1,54 (3H)
Vb	6,26 d	~5,10 m	~5,10 m	4,56 dd	~5,10 m	3,84 dd	3,66 dd	1,90s 1,96s 2,02s	2,36 s (3H), 7,26 d (2H), 7,68 d (2H)	
Vc	5,94	4,94	5,03 d	4,42 dd	5,16 dt	3,88 dd	3,66 dd	2,04s 2,08s	2,36 s (3H), 7,22 d (2H), 7,64 d (2H)	1,66 d (3H), 5-CH_3 (J=1,2 Hz); 6,80 d (1H), 6-H; 9,58 br s (1H), NH
VIa	6,18 s	5,20 m	5,20 m	4,74 dd	5,20 m	3,88 dd	3,50 dd	2,00s 2,14 s *	2,50 s (3H), 7,50 d (2H), 7,94 d (2H)	
VIb	6,26 d	~5,20 m	5,20 m	4,68 dd	5,20 m	3,74 dd	3,50 dd	2,04 s 2,08 s	2,48 s (3H), 7,46 d (2H), 7,90 d (2H)	
VIc	6,02 d	5,04 d	5,14 d	4,54 dd	5,26 dt	3,84 dd	3,44 dd	2,12 s *	2,22 s (3H), 7,40 d (2H), 7,84 d (2H)	7,26 d (1H), 6-H (J=8,0 Hz); 5,66 d (1H), 5-H; 10,16 br s (1H), NH
VId	6,22 d	5,84 dd	5,18 dd	4,44 dd	5,34 dt	3,72 dd	3,40 dd	2,04 s 1,95 s	2,42 s (3H), 7,30 d (2H), 7,88 d (2H)	~7,40, 6-H; 5,74 d (1H), 5-H (J=8,0 Hz); 10,68 br s (1H), NH

*Two acetyl groups (6H).

TABLE 2. Spin–Spin Coupling Constants (SSCC) of the Carbohydrate Protons of IIIa,b, IVb, Vb,c, and VIa-d

Compound	SSCC, Hz						
	1,2	2,3	3',4	4,5	5,6	5,6'	6,6'
IIIa	3,5	<0,5	3,0	9,0	2,5	3,5	12,5
IIIb	3,8	<0,5	2,8	9,0	4,0	6,0	14,0
IVb	3,8	3,8	2,5	9,0	~4,0	5,0	14,0
Vb	4,3		4,6	9,0	2,8	3,0	12,4
Vc	2,0	<0,5	3,0	9,2	2,4	2,4	12,2
VIa	0,5		4,35	9,5	3,25	3,25	14,0
VIb	4,0		4,0	9,5	3,0	3,0	13,5
VIc	1,5	<0,5	3,0	10,0	3,0	3,0	13,0
VId	4,5	2,0	5,0	8,5	4,0	4,0	13,5

[6-9]. The problem is simplified when two anomers are present: The 1-H (1'-H) signal is observed at weaker field in the case of a cis orientation of the 1,2 (1',2') substituents as compared with the trans orientation. In addition, the $J_{1,2}$ ($J_{1',2'}$) value for the β anomers of D-xylofuranose derivatives is smaller than that for the α anomers [8, 9]. The application of these empirical rules made it possible to assign the anomeric configuration of the investigated compounds (Tables 1 and 2). An additional confirmation of the α-anomeric configuration of nucleoside VId is provided by the shift of the resonance signal of the methyl group of the acetyl group attached to C_2' to strong field as a result of the shielding effect of the heterocyclic base [10, 11]. In the case of the VIc,d pair it is also apparent that the 2'-H signal and the signal of the methyl group of the p-toluenesulfonate are shifted to weak field on passing from the β- to the α-anomeric configuration. These changes are undoubtedly due to elimination of the shielding effect of the heterocyclic base.

The formation of α-anomers Vd and VId in the reactions of acetates Va,b and VIa,b with the silyl derivatives of thymine and uracil (Ib and Ia) in the presence of $SnCl_4$ is of definite interest. In fact, in various syntheses of O- and N-glycosides the presence of an acetyl group attached to C_2 of the carbohydrate component usually leads to the formation of glycosides with a 1,2-trans orientation of the substituents [12]; however, there are exceptions (for example, see [13]). We assume that ions with coparticipation of other groups [14, 15] and/or more remote acyl groups [16] may be formed in some cases together with the primary formation of a 1,2-O-acyloxonium ion by the action of $SnCl_4$ on a peracyl sugar. Such competitive processes may lead to disruption of the stereochemical unambiguity of the glycoside synthesis. It is extremely likely that in the reactions that we investigated the formation of an α anomer is due to coparticipation of the 3-O-tosyl and/or 5-O-acetyl group in the intermediate ions. This type of coparticipation may fulfill two functions: First, it may result in the formation of a reactive ion that, by reacting with the heterocyclic base, would give the α anomer; second, it may "trigger" the reaction of α-acetates Vb and VIb with $SnCl_4$ with the subsequent formation of a more stable 1,2-O-acyloxonium ion (compare with the data in [17] on the reactivities of D-glucopyranose α- and β-pentaacetates).

EXPERIMENTAL

The ^1H NMR spectra of 10% solutions of the compounds in $CDCl_3$ (or CCl_4 in the case of IVb) were recorded with a JEOL JNM PS-100 spectrometer with tetramethylsilane as the internal standard. The IR spectra were recorded with a Carl Zeiss UR-10 spectrometer. The $[\alpha]_D$ values were obtained with a JASCO J-20 spectropolarimeter. Thin-layer chromatography (TLC) was carried out on a loose layer of Woelm (West Germany) silica gel (A) or aluminum oxide (B) on Silufol UV-254 plates (Czechoslovakian SSR) with the following solvent systems: 1) acetone–hexane (1:2), 2) acetone–hexane (4:1), 3) acetone–water (30:1), and 4) chloroform–methanol (8:1).

Reaction of 5-O-Acetyl-6-chloro-6-deoxy-1,2-O-isopropylidene-3-O-(p-tolylsulfonyl)-α-D-glucofuranose (II) with Sodium Azide. A) A 4.8-g (74 mmole) sample of sodium azide was added to a solution of 6.4 g (14.7 mmole) of II [4] in 20 ml of anhydrous dimethylformamide (DMF), and the reaction mixture was heated with stirring at 100°C for 35 h. The solid residue was removed by filtration, and the filtrate was evaporated *in vacuo* with n-butanol and cyclohexane. The oily residue was treated with chloroform–water (1:1), and the chloroform layer was washed with water, dried over anhydrous sodium sulfate, and evaporated *in vacuo*. According to TLC

(A-1, two-stage chromatography), the residue contained two substances with R_f 0.50 (detected in UV light and with iodine vapors) and R_f 0.53 (detected only with iodine vapors). Two crystallizations of the residue (6.4 g) from light petroleum ether–ethanol (1:1) gave 4.3 g (66%) of 5-O-acetyl-6-azido-6-deoxy-1,2-O-isopropylidene-3-O-(p-tolylsulfonyl)-α-D-glucofuranose (IIIa) with R_f 0.50, mp 74-76°C, and $[\alpha]_D^{20}$ − 17.7° (c 0.70, ethanol). IR spectrum (KBr): 1750 (C=O, Ac), 2110 (N_3), and 1600 cm^{-1} (Ts). Found:C 49.0; H 5.2; N 9.4; S 7.2%. $C_{18}H_{23}N_3O_8S$. Calculated: C 49.0; H 5.2; N 9.5; S 7.3%.

A 1-g (2.27 mmole) sample of monoazide IIIa was hydrogenated over 5% Pd/C (0.5 g) in 100 ml of anhydrous methanol (with monitoring by TLC). At the end of the reaction (after 2.5 h) the catalyst was removed by filtration, the filtrate was evaporated to dryness *in vacuo*, and the residue was dissolved in 5 ml of anhydrous pyridine. Acetic anhydride (1 ml) was added to the solution, and the mixture was maintained at 20°C for 24 h. It was then evaporated to dryness *in vacuo*, and the residue was dissolved in benzene and applied to a column filled with SiO_2 (30 cm^3). Elution with benzene gave 0.2 g of an oily mixture of unidentified products. Further elution with chloroform gave 0.75 g (73%) of an oily substance that was an individual substance (according to TLC) and began to crystallize on standing. Crystallization from acetone–hexane gave 0.6 g (59%) of 5-O-acetyl-6-acetamido-6-deoxy-1,2-O-isopropylidene-3-O-(p-tolylsulfonyl)-α-D-glucofuranose (IIIb), R_f 0.28 (B-1; the spot was identified in UV light and with iodine vapors), mp 132-135°C, and $[\alpha]_D^{20}$ −1.7° (c 1.2, methanol). IR spectrum (CCl_4): 1750 (C=O, Ac), 1660 (C=O, —CO—NH), 3460 and 1520 (NH), 1600 (Ts), and 1375 cm^{-1} (gem-dimethyl groups). Found: C 52.8; H 5.9; N 2.9; S 6.8%. $C_{20}H_{27}NO_9S$. Calculated: C 52.2; H 5.9; N 3.1; S 7.0%.

B) A 5-g (77 mmole) sample of sodium azide was added to a solution of 5.5 g (12.7 mmole) of II in 100 ml of anhydrous DMF, and the reaction mixture was stirred at 150-160°C for 30 h. The solid residue was separated, and the filtrate was evaporated *in vacuo* with n-butanol. The oily residue was treated with chloroform, the undissolved part was removed by filtration, and the filtrate was evaporated to dryness *in vacuo*. The residue (2 g) was dissolved in 25 ml of anhydrous pyridine, 2 ml of acetic anhydride was added, and the mixture was maintained at 20°C for 24 h. The reaction mixture was then evaporated to dryness *in vacuo*, and the residue was dissolved in benzene and applied to a column filled with SiO_2 (50 cm^3). Elution with benzene gave 1.2 g of an oily substance that, according to TLC (A-1, two-stage chromatography), contained two substances with R_f 0.50 and 0.53. This mixture was hydrogenated with hydrogen in methanol over 5% Pd/C, and the reaction mixture was worked up in the same way as described above. The reaction products were separated by column chromatography on SiO_2 (50 cm^3). Elution with chloroform gave 0.4 g of amide IIIb; recrystallization from hexane–acetone gave 0.3 g (5.2%) of amide IIIb. Subsequent elution with chloroform and chloroform–ethanol (9:1) gave 0.5 g (11.7%) of an oily substance with R_f 0.60 (B-2; the spot was detected only by means of iodine vapors). Trituration with hexane gave crystalline 5-O-acetyl-3,6-diacetamido-3,6-dideoxy-1,2-O-isopropylidene-α-D-allofuranose (IVb) with mp 85-90°C. IR spectrum (CCl_4): 1745 (C=O, Ac), 1665 (C=O, —CO—NH—), 3300 and 1560 (NH), and 1380 cm^{-1} (gem-dimethyl groups). Found: C 52.4; H 7.0; N 8.2%. $C_{15}H_{24}N_2O_7$. Calculated: C 52.3; H 7.0; N 8.1%.

1,2,5-Tri-O-acetyl-3-O-(p-tolylsulfonyl)-6-chloro-6-deoxy-D-glycofuranose (Va,b). A 2.7-g sample of II was added to a cooled (to +4°C) mixture of 15 ml of glacial acetic acid, 1.5 ml of acetic anhydride, and 0.8 ml of concentrated H_2SO_4, and the mixture was maintained at 20°C for 24 h. It was then poured into ice water, and the aqueous mixture was extracted with chloroform (three 70-ml portions). The combined chloroform extracts were washed with water and a saturated solution of $NaHCO_3$, dried over anhydrous sodium sulfate, and evaporated *in vacuo* to give 2.6 g (82.6%) of an oily substance that was an individual compound according to TLC; however, according to ^1H NMR spectroscopy, the product was a mixture of α and β anomers (α/β = ~0.9).

In another similar experiment we also obtained an oily mixture of α and β anomers, which began to crystallize after drying. Crystallization from alcohol gave the α anomer, with mp 123-124°C and $[\alpha]_D^{20}$ +45.2° (c 1.09, methanol), in 28% yield. Found: C 47.2; H 4.7; Cl 7.2; S 6.5%. $C_{19}H_{23}ClO_{10}S$. Calculated: C 47.6; H 4.8; Cl 7.4; S 6.7%.

1-[2,5-Di-O-acetyl-3-O-(p-tolylsulfonyl)-6-chloro-6-deoxy-β-D-glucofuranosyl]thymine (Vc). A) A solution of 17 g (36 mmole) of acetates Va,b (a mixture of β and α anomers), 9.65 g (36 mmole) of bis(trimethylsilyl)thymine, and 9.3 g [4.16 ml (36 mmole)] of $SnCl_4$ in 500 ml of anhydrous dichloroethane was stirred at 20°C without access to moisture for 3 days, after

which a saturated aqueous solution of $NaHCO_3$ (500 ml) was added to the reaction mixture, and the organic layer was separated, washed with water, dried over anhydrous Na_2SO_4, and evaporated *in vacuo*. The oily residue was dissolved in benzene and applied to a column filled with SiO_2 (200 cm^3). Elution with benzene gave 6.5 g of a mixture of β and α anomers Va,b enriched in the latter compound; crystallization from alcohol gave 3.2 g of 1,2,5-tri-O-acetyl-3-O-(p-tolylsulfonyl)-6-chloro-6-deoxy-α-D-glucofuranoside (Vb) with mp 123-124°C and $[\alpha]_D^{20}$ +46.0° (c 1.1, methanol). Elution with chloroform gave 11 g of an oily product that, according to TLC, contained two substances with R_f 0.43 and 0.59 (B-3; the spots were detected in UV light). Crystallization from alcohol gave 4.65 g (37.2%) of Vc with R_f 0.43 and mp 163-164°C and $[\alpha]_D^{20}$ −25° (c 4.5, chloroform). UV spectrum (in methanol), λ_{max} (log ε): 256 (3.98) and 223 nm (4.26). Found: C 48.5; H 4.8; Cl 6.0; N 5.0; S 5.4%. $C_{22}H_{25}ClN_2O_{10}S$. Calculated: C 48.5; H 4.8; Cl 6.5; N 5.1; S 5.8%.

B) β Nucleoside Vc was similarly obtained in 70% yield (0.37 g of an oil) and 40% yield (0.2 g of crystals) by condensation of 0.6 g (1.3 mmole) of α anomer Vb with 0.34 g (1.3 mmole) of bis(trimethylsilyl)thymine in the presence of 0.09 g [0.2 ml (1.3 mmole)] of $SnCl_4$ in 30 ml of anhydrous dichloroethane for 6 days. The yields are indicated with allowance for the unchanged starting acetate Vc (0.13 g).

1,2,5-Tri-O-acetyl-3-O-(p-tolylsulfonyl)-6-azido-6-deoxy-D-glucofuranose (VIa,b). A 1.2-g sample of azide IIIa was added to a cooled (to +4°C) mixture of 0.94 ml of acetic anhydride, 9.4 ml of acetic acid, and 0.5 ml of concentrated H_2SO_4, and the mixture was maintained at 20°C for 24 h. It was then poured into ice water (20 ml) containing 5 g of $NaHCO_3$, and the aqueous mixture was extracted with chloroform (three 30-ml portions). The combined chloroform extracts were washed with water (three 25-ml portions), dried over anhydrous sodium sulfate, and evaporated to dryness *in vacuo* with the addition of anhydrous benzene to give 0.83 g (80%) of an oily substance that was an individual compound according to TLC [R_f 0.55 (B-1)] and a mixture of α and β anomers ($\alpha/\beta \cong 1$) according to ^1H NMR spectroscopy.

In another similar experiment we also obtained an oily mixture of α and β anomers, which began to crystallize on standing. Crystallization from alcohol gave α anomer VIb, with mp 100-101.5°C and $[\alpha]_D^{20}$ +94.0° (c 0.96, chloroform), in 15% yield. IR spectrum (ethanol-free chloroform): 1755 (C=O, Ac), 1600 (Ts), and 2115 cm^{-1} (N_3). Found C 46.7; H 4.6; N 8.7; S 6.7%. $C_{19}H_{23}N_3O_{10}S$. Calculated: C 47.0; H 4.8; N 8.6; S 6.6%. Fractional crystallization of the residue from ethanol gave β anomer VIa with mp 107-109°C and $[\alpha]_D^{20}$ −42.0° (c 0.96, chloroform). Found: C 46.7; H 4.6; N 8.7; S 6.7%. $C_{19}H_{23}N_3O_{10}S$. Calculated: C 47.0; H 4.8; N 8.6; S 6.6%. The characteristic frequencies noted for the α anomer were present in the IR spectrum.

1-[2,5-Di-O-acetyl-3-O-(p-tolylsulfonyl)-6-azido-6-deoxy-D-glucofuranosyl]uracil (VIc, d). A solution of 5 g (10.3 mmole) of acetates VIa,b (a mixture of β and α anomers), 2.64 g (10.3 mmole) of bis(trimethylsilyl)uracil, and 2.25 g [1.22 ml (10.3 mmole)] of $SnCl_4$ in 200 ml of anhydrous dichloroethane was stirred at 20°C without access to moisture for 6 days, after which a saturated aqueous solution of $NaHCO_3$ (200 ml) was added to the mixture, and the organic layer was separated, washed with water, dried over anhydrous sodium sulfate, and evaporated to dryness *in vacuo*. The oily residue was dissolved in chloroform and applied to a column filled with silica gel L (Czechoslovakian SSR, 40/100 μ, 300 cm^3). Elution with chloroform gave (in the first fractions) 1 g (20%) of oily 1,2,5-tri-O-acetyl-3-O-(p-tolylsulfonyl)-6-azido-6-deoxy-α-D-glucofuranoside (VIb), crystallization of which from alcohol gave 0.71 g (14.2%) of a product with mp 102-103°C, R_f 0.73 (A-4), and $[\alpha]_D^{20}$ +93.8° (c 1.0, chloroform). Further elution with chloroform gave successively 2.3 g (41.6%) of β anomer VIc and 0.83 g (15%) of α anomer VId. Both of the individual (according to TLC) anomers (B-4, R_f 0.25 for the α anomer, R_f 0.33 for the β anomer) were obtained in oily form. Anomer VIc began to crystallize upon prolonged storage; however, it could not be recrystallized.

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AMINOMETHYLATION OF 1,2,4-TRIAZOLES AND TETRAZOLES

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Aminomethylation was accomplished in a series in which the starting amino compounds and the components of acidic character belong to the azole class. Two-ring Mannich bases are formed in the reaction of 4-amino-1,2,4-triazole or N-methyl-5-aminotetrazole in an aqueous medium with formaldehyde and NH-triazoles, the acidic properties of which are known.

Little study has been devoted to aminomethylation in the triazole and tetrazole series. The scanty data that are available relative to this problem pertain to the reaction of some CH acids of the nitroalkane series with formaldehyde and 4-amino-1,2,4-triazole [1] or 5-aminotetrazole [2]. We have for the first time accomplished aminomethylation in a series in which both the starting amino compounds and the components of acidic character belong to the azole class.

Two-ring Mannich bases — 4-aminomethylene(3-X-5-R-1,2,4-triazol-1-yl)triazoles (VIII-XIII) — are formed in the reaction of 4-amino-1,2,4-triazole with formaldehyde and NH triazoles I-VI.

Compounds of the same type, viz., 1-methyl-5-aminomethylene(3-X-5-R-1,2,4-triazol-1-yl)-tetrazoles (XIV, XV), are formed in the reaction of NH triazoles II and VII with 1-methyl-5-aminotetrazole.

An increase in the yields of the described Mannich bases is observed as the acidities of the starting NH-triazoles I-VII, the properties of which are known [3], increase. In the reaction scheme and in Table 1 VIII-XV are arranged in orders corresponding to the increase in the acidic properties of the starting compounds from pK_a 10.08 for 1,2,4-triazole (I) to pK_a 3.05 for 3-nitro-5-bromo-1,2,4-triazole (VII).

The position of the signals in the PMR spectra of the Mannich bases for the protons of the methylene groups, which link the nitrogen atom of the heteroring of the triazole (an acid) with the amino group, changes somewhat as a function of the electronic and magnetic effects of the substituents in the 3 and 5 positions of the triazole ring. The protons attached to the carbon atoms of the 4-amino-1,2,4-triazole heteroring in VIII-XIII are sterically equivalent and give a singlet at 8.1-8.4 ppm in the spectra of all of the compounds.

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