The composition and structures of (IIa)-(IIg) were supported by elemental analysis and ^1H, ^{19}F, and ^{31}P NMR spectroscopy.

The PMR spectra of (II) show characteristic doublets for the methyl group bound to the phosphorus atom at 1.90 ppm with $^2J_{PH}$ = 16 Hz and doublets for the NH protons at 6.2-6.4 ppm with $^3J_{PH}$ = 9 Hz. The ^{19}F NMR spectra of (IIb)-(IIg) show two quartets (at 8-9 and 13-14 ppm with $^4J_{FF}$ = 9 Hz) due to lack of equivalence of the trifluoromethyl groups. The phosphorus atom signals in the ^{31}P NMR spectra of (II) are found at 41-44 ppm, which indicates the phosphine structure of (II) [5].

EXPERIMENTAL

The ^1H, ^{19}F, and ^{31}P NMR spectra were taken on a Bruker CXP 200 spectrometer in $CDCl_3$.

Reaction of 1,4,2-Oxazaphospholine with OH-Nucleophiles. A sample of 0.01 mole water or corresponding alcohol was added dropwise to a solution of 0.01 mole (I) in 10 ml ether at 20°C. The solvent was evaporated after 24 h. Products (IIa) and (IIc) were dried in vacuum, while (IIb) and (IId)-(IIg) were distilled.

The yields, properties, elemental analyses, and NMR spectral data for (IIa)-(IIg) are given in Tables 1 and 2.

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SYNTHESIS OF 5-AZAADENINE DERIVATIVES FROM N-(1,2,4-TRIAZOL-5-YL)AMIDINES

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A method is proposed for the synthesis of N-substituted 5-azaadenines. The condensation of N-(1,2,4-triazol-5-yl)amidines with trichloroacetonitrile gives trichloromethyl derivatives of 1,2,4-triazolo[1,5-a]-1,3,5-triazines, which are converted by the action of primary or secondary amines into N-alkylamino- or N,N-dialkylamino-1,2,4-triazolo-[1,5-a]-1,3,5-triazines (5-azaadenines).

N-(1,2,4-Triazol-5-yl)amidines (TA), which we described in a previous work [1], are used as reagents in heterocyclic synthesis [2]. Thus, the reaction of TA with ethyl orthoformate is a simple, convenient method for obtaining the 5-azapurine system. Fusion of a triazine ring to a triazole ring may apparently be achieved by reactions of TA with other one-carbon synthones. In the present work, TA were used as starting compounds for the synthesis of 5-azaadenines substituted at the exocyclic nitrogen atom.

Free bases of TA obtained in situ from TA hydrochlorides (Ia) and (Ib) react with CCl_3CN to give the corresponding trichloromethyl derivatives of 1,2,4-triazolo[1,5-a]-1,3,5-triazines (IIa) and (IIb) in 58-78% yield.

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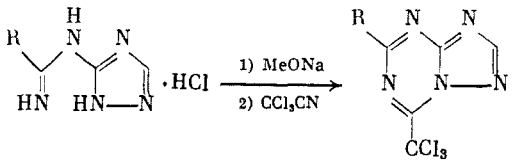
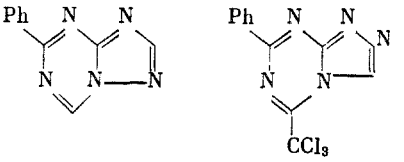


(Ia, b) (IIa, b)

R = Ph (a); R = Me(b).

Triazines (IIa) and (IIb) are colorless, crystalline compounds, soluble in chloroform and acetone and crystallizable from hexane. Their mass spectra show strong molecular ion peaks. The PMR spectra of (IIa) and (IIb) in $CDCl_3$ show a signal at 8.6-8.7 ppm characteristic for the triazole proton of the 5-azapurine system [2] in addition to the signals of the hydrocarbon substituents R.

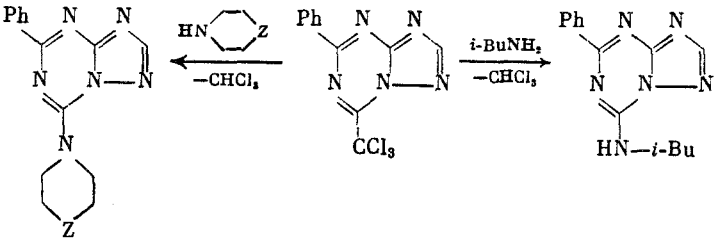
The structures of (IIa) and (IIb) were supported by the ^{15}N NMR chemical shifts and $J_{^{15}N,^{1}H}$ coupling constants in the ^{15}N NMR spectra analogously to the procedure for 7-phenyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (III) [2].



(III) (IVa)

The signals for N^6 and N^8 in the compounds synthesized from (Ia) and CCl_3CN were singlets, while the signals for N^1, N^3, and N^4 were doublets with $J_{^{15}N,^{1}H}$ constants, which corresponded to the structure of (IIa) (Table 1). In the case of alternative structure (IVa), (1,2,4-triazolo[4,3-a]-1,3,5-triazine), at least one of the coupling constants ($^3J_{^{15}N,^{1}H}$ for pyridinyl N^1) should not exceed 1-3 Hz [3-6] (a more detailed discussion is given in our previous work [2]).

Treatment of (IIa) by piperidine, morpholine, or isobutylamine under mild conditions leads to the corresponding 5-azaadenines (V)-(VII) in 90-95% yield.



(IIa) (VII)

Z = CH_2 (V), O (VI).

Heterocycles (V)-(VII) are colorless, crystalline compounds, which are soluble in chloroform, acetone, and benzene. Their mass spectra show strong $M^{+\cdot}$ peaks. The signal for the triazole proton in the PMR spectra of (V)-(VII) is shifted by about 0.5 ppm upfield in comparison with (IIa) and (IIb).

Thus, the cyclization of N-(1,2,4-triazol-5-yl)amidines with trichloroacetonitrile to give azapurines (II) with the subsequent action of primary or secondary amines on (II) is a simple method for the synthesis of N-substituted 5-azaadenines. The reported methods for the preparation of 5-azaadenines from N,N′-bis(1,2,4-triazol-5-yl)formamidine and calcium cyanamide [7], from 5-amino-1,2,4-triazole and ethoxymethylenecyanamide [8], and from 1-amidino-3--R-5-amino-1,2,4-triazole and formic acid [9] lead only to compounds with an unsubstituted NH_2 group.

EXPERIMENTAL

Starting (Ia) and (Ib) were obtained according to our previous procedure [1]. The IR spectra (ν, cm^{-1}) were taken on a UR-20 spectrometer. The mass spectra (m/z) were taken on a

TABLE 1. ^{15}N NMR Spectral Parameters for (IIa)*

Parameter	N^1	N^3	N^4	N^6	N^8
δ, ppm †	−146,95 (−149,66)	−104,72 (−108,64)	−166,58 (−153,73)	−130,82 (−135,30)	−138,07 (−137,45)
$J_{^{15}N,H^2}$, Hz	13,0 (13,6)	16,3 (15,3)	6,5 (11,0)	–	–

*The corresponding data for (III) [2] are given in parentheses.
†Measured relative to CH_3NO_2 as the external standard.

Varian MAT CH-6 mass spectrometer with direct sample inlet into the ion source at 70-100°C. The PMR spectra (δ, ppm) were taken on a Bruker WM-250 spectrometer at 250 MHz. The ^{15}N NMR spectra were taken on a Bruker AM-300 spectrometer at 30.42 MHz with natural isotope content. A 0.3 g/ml solution of the sample in C_6D_6 was placed into NMR tube with 10 mm diameter. The spectrum was taken at 60°C.

5-Trichloromethyl-7-phenyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (IIa). An equivalent amount of 0.49 N MeONa in methanol was added to 0.002 mole (Ia) and stirred for 15 min. Methanol was removed in vacuum. The residue was heated at reflux with 1 ml CCl_3CN and 6 ml xylene for 4 h. The reaction mixture was evaporated to dryness and the residue of (IIa) was extracted with hot hexane. The yield of (IIa) was 78%, mp 168-170°C (from hexane). Found: C, C, 42.17; H, 2.03; Cl, 34.28; N, 22.14%. Calculated for $C_{11}H_6Cl_3N_5$: C, 42.00; H, 1.93; Cl, 33.81; N, 22.27%. Mass spectrum: 313 ($M^{+\cdot}$). PMR spectrum in $CDCl_3$: 8.77-8.64 m and 7.69-7.52 m (Ph), 8.68 s (CH).

5-Trichloromethyl-7-methyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (IIb) was obtained by analogy to (IIa) from (Ib) and CCl_3CN in 58% yield, mp 118-122°C (from hexane). Found: C, 28.41; H, 1.52; Cl, 41.87; N, 28.05%. Calculated for $C_6H_4Cl_3N_5$: C, 28.54; H, 1.60; Cl, 42.12; N, 27.74%. Mass spectrum: 201 ($M^{+\cdot}$). PMR spectrum in $CDCl_3$: 8.64 s (CH), 2.96 s (Me).

5-Piperidino-7-phenyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (V). A mixture of 0.252 g (IIa), 0.1 ml piperidine, and 4 ml benzene was stirred for 2 h at ~20°C and evaporated to dryness. The residue was dried in vacuum above P_2O_5. The yield of (V) was 0.2 g (90%), mp 176-180°C (from benzene). Found: C, 64.44; H, 5.88; N, 29.53%. Calculated for $C_{15}H_{16}N_6$: C, 64.27; H, 5.76; N, 29.98%. Mass spectrum: 280 ($M^{+\cdot}$). PMR spectrum in $(CD_3)_2CO$: 8.52-8.43 m and 7.57-7.43 m (Ph), 4.47 m ($(CH_2)_2N$), 1.82 br.s ($(CH_2)_3$), 8.27 s (CH).

5-Morpholino-7-phenyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (VI) was obtained by analogy to (V) from (IIa) and morpholine in 91% yield, mp 203-205°C (from benzene). Found: C, 59.49; H, 5.05; N, 29.29%. Calculated for $C_{14}H_{14}N_6O$: C, 59.56; H, 5.00; N, 29.77; O, 5.68%. Mass spectrum: 282 ($M^{+\cdot}$). PMR spectrum in $(CD_3)_2CO$: 8.53-8.45 m and 7.58-7.46 m (Ph), 8.32 s (CH), 4.54 m ($(CH_2)_2N$), 3.90 t ($(CH_2)_2O$).

5-Isobutylamino-7-phenyl-1,2,4-triazolo[1,5-a]-1,3,5-triazine (VII) was obtained by analogy to (V) from (IIa) and isobutylamine in 95% yield, mp 178-180°C (from benzene). Found: C, 62.37; H, 5.74; N, 31.80% Calculated for $C_{14}H_{16}N_6$: C, 62.67; H, 6.01; N, 31.32%. Mass spectrum: 268 ($M^{+\cdot}$). PMR spectrum in $(CD_3)_2CO$: δ.58-8.50 m and 7.59-7.46 m (Ph), 8.33 s (CH), 3.74-3.65 m (N–CH_2), 2.32-2.15 m (CH_2–CH), 1.06 d (2Me). IR spectrum in $CHCl_3$: ν NH 3410 cm^{-1}.

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