Pyrano[4,3-*d*]pyrimidinium salts
4.* Transformations of 5,7-diaryl-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrano[4,3-*d*]pyrimidinium bromides under the action of phenylhydrazines and aromatic acid hydrazides

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Reactions of 5,7-diaryl-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrano[4,3-*d*]pyrimidinium bromides with phenylhydrazines and aromatic acid hydrazides have been studied. The reaction of the salts indicated with phenylhydrazine at ~20 °C results in the pyrylium ring opening, whereas elevated temperature leads to recyclization products, *i.e.*, 1,3-dimethylpyrido[4,3-*d*]pyrimidine-2,4(1*H*,3*H*)-diones. The reactions of the starting bromides with *m*-carboxyphenylhydrazine and aromatic acid hydrazides lead to 6-(R-amino)-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrido[4,3-*d*]-pyrimidinium salts.

Key words: pyrano[4,3-*d*]pyrimidinium salts, phenylhydrazine, hydrazone, X-ray diffraction analysis, pyrido[4,3-*d*]pyrimidines, aromatic acid hydrazides, recyclization, pyrido[4,3-*d*]-pyrimidinium salts.

Earlier,[2] we have reported that 5,7-diaryl-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrano[4,3-*d*]pyrimidinium bromides **1** upon a short-time heating with equimolar amount of hydrazine undergo recyclization to 1*H*-pyrimido[5,4-*d*]-[1,2]diazepine-2,4(3*H*,9*H*)-dione hydrobromides **2**. At the same time, compounds **1** and **2** upon treatment with excess hydrazine for 30 min are transformed to 6-amino-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium salts **3** (Scheme 1).

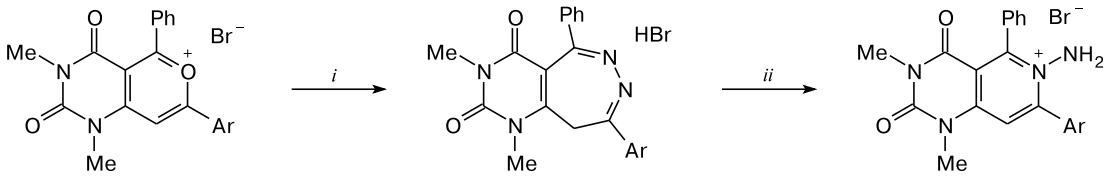
Analogous transformations of benzo[*c*]pyrylium salts are also described, however, structures of the products depends differently on the reaction conditions: the action of equimolar amount of hydrazine results in recyclization to *N*-aminoisoquinoline derivatives, whereas excess nucleophile leads to the pyrylium ring expansion and formation of benzo-2,3-diazepines.[3—5]

The reactions of benzo[*c*]pyrylium salts with phenylhydrazine and aromatic acid hydrazides under various conditions furnish *N*-(R-amino)isoquinolinium derivatives,[6—8] benzo-2,3-diazepines,[8,9] or yield mixtures of both products.[5]

In the present work, we study reactions of 5,7-diaryl-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrano[4,3-*d*]pyrimidinium salts **1** with phenylhydrazines and aromatic acid hydrazides.

* For Part 3, see Ref. 1.

Scheme 1



1 **2** **3**

i. 1 min; *ii*. 30 min.

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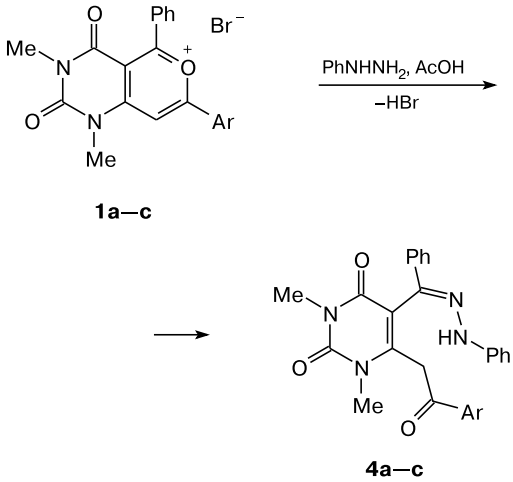
We found that the reaction of pyrimidopyrylium bromides **1a—c** with phenylhydrazine in glacial acetic acid at ~20 °C results in the formation of 1,3-dimethyl-6-(2-aryl-2-oxoethyl)-5-[phenyl(phenylhydrazono)methyl]pyrimidine-2,4(1*H*,3*H*)-diones **4a—c** (Scheme 2).

Scheme 2



Ar = Ph (**a**), 4-BrC_6H_4 (**b**), 4-$MeOC_6H_4$ (**c**)

The structures of products **4a—c** are established by spectroscopic methods. The structure of compound **4b** is confirmed by X-ray diffraction analysis. The ^{1}H NMR spectra of products **4** exhibit the signals for the CH_2 protons in the form of two doublets in the region δ 4.00—4.29 with the spin-spin coupling constant of 17.89 Hz, which do not disappear by deuteration and do not change on heating. The singlet in the region δ 7.57—7.88 disappearing on deuteration was assigned by us to the proton of the NH group. In the IR spectra, there are found bands in the region 1646—1713 cm^{-1} related to the stretching vibrations of the C=O groups and the maximum at ~3290 cm^{-1} corresponding to the NH group. In the mass spectrum of compound **4a**, there is a molecular ion peak with *m/z* 452 $[M]^+$, as well as peaks with *m/z* 375 $[M - C_6H_5]^+$, 333 $[M - C_6H_5COCH_2]^+$.

According to the X-ray analysis data, compound **4b** is crystallized in the center-symmetric space group (*P*-1). The crystal contains two crystallographically independent molecules (**A** and **B**) and one solvate ethanol molecule.

Molecules **A** and **B** are two conformers differing in the degree of turning of the substituent on the atom C(5) with respect to the C(5)—C(7) bond (Figs 1 and 2). The differences observed lead to a change in the type of hydrogen bonds. In molecule **A**, there is present intramolecular hydrogen bond N(4A)—H(4NA)...O(21A) (the distance H(4NA)...O(21A) is 2.25(4) Å, the distance N(4A)...O(21A) is 2.980(4) Å, the angle N(4A)—H(4NA)—O(21A) is 141(3)°). In molecule **B**, the N(4B)—H(4NB) group forms

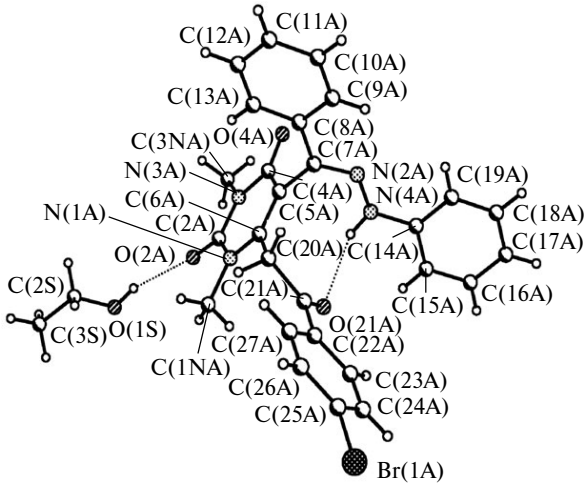


Fig. 1. Molecular structure of conformer **A** of compound **4b**.

a weak intermolecular hydrogen bond with atom O(2B) (the distance H(4NB)...O(2B) is 2.30(3) Å, the angle N(4B)—H(4NB)—O(2B) is 156(4)°). The solvate molecule of alcohol, in turn, is involved into the formation of hydrogen bond with the O atom of the uracil fragment of molecule **A** (O(1S)—H(1OS)...O(2A), the distance H(1OS)...O(2A) is 2.06(5) Å, the distance O(1S)...O(2A) is 2.867(4) Å, the angle O(1S)—H(1OS)—O(2A) is 156(4)°). The intermolecular interactions Br(1A)...N(2A) [$-x$, $1-y$, $2-z$] (3.1250(2) Å) combine molecules **A** in dimers, which are additionally stabilized by the stacking-interaction between the phenyl rings of the 4-bromophenacyl substituent (the distance between atoms C(26A) and C(23A) [$-x$, $1-y$, $2-z$] is 3.6918(4) Å). Despite the difference in the nature and stability of the H-bonds, the bond dis-

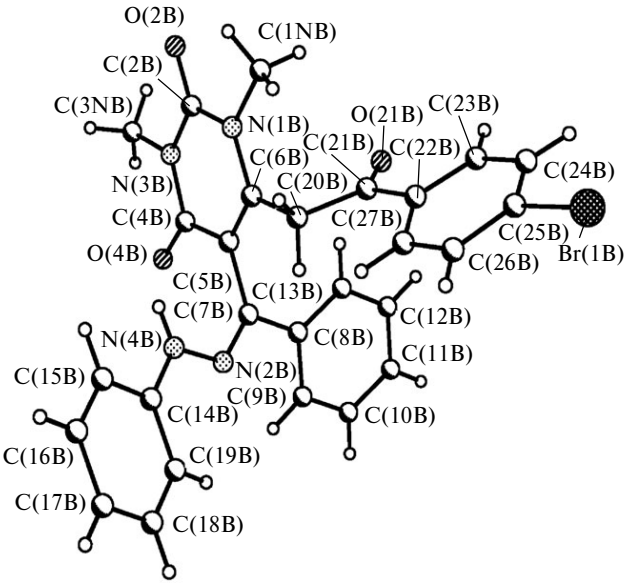
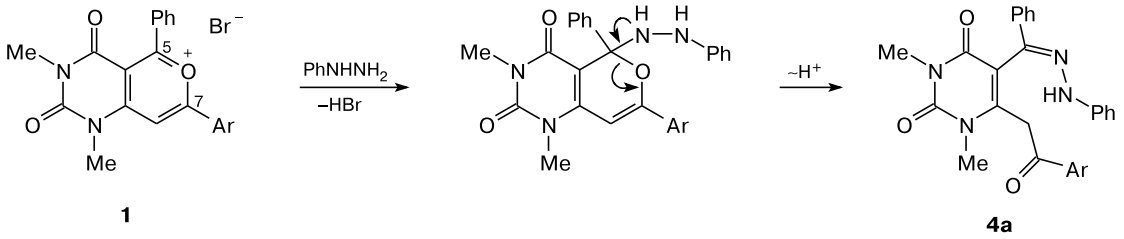


Fig. 2. Molecular structure of conformer **B** of compound **4b**.

Scheme 3



1 **4a**

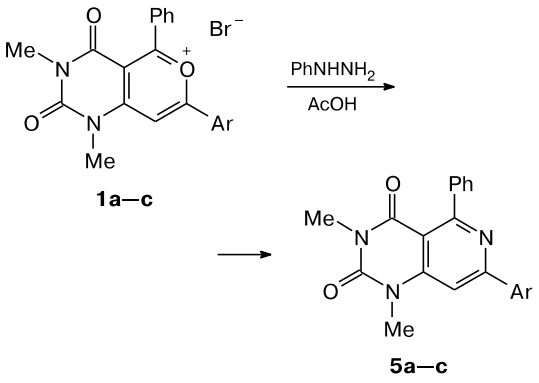
tances in the two independent molecules **A** and **B** are virtually the same, and the uracil fragment geometry is close to the geometry of 1,3-dimethyluracil[10] (Table 1).

The fact that the reaction under consideration leads to hydrazones **4** definitely indicates a predominance of the nucleophilic attack at position 5 rather than at position 7 of the pyrylium ring in the molecules of compound **1** (Scheme 3).

According to the literature data,[11,12] the formation of the pyrylium ring opening products upon the action of N-nucleophiles occurs extremely rare and so far has not been known in the series of pyrano[4,3-*d*]pyrimidinium salts.

We found that pyrimidopyrylium bromides **1a—c** upon heating with phenylhydrazine in glacial acetic acid for 2 h are converted to 5,7-diaryl-1,3-dimethylpyrido[4,3-*d*]-pyrimidine-2,4(1*H*,3*H*)-diones **5a—c** (Scheme 4).

Scheme 4



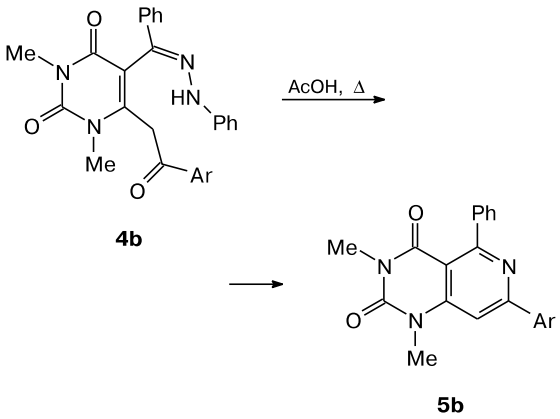
1a—c **5a—c**

Ar = Ph (**a**), 4-BrC_6H_4 (**b**), 4-$MeOC_6H_4$ (**c**)

The structures of products **5a—c** were confirmed by alternative synthesis from salts **1a—c** and ammonia in aqueous ethanol according to the procedure described earlier.[13]

We suggested that hydrazones **4** obtained at ~20 °C are intermediate compounds in the reaction leading to pyrido[4,3-*d*]pyrimidine-2,4(1*H*,3*H*)-diones **5** upon heating pyrimidopyrylium salts **1** with phenylhydrazine. In fact, after heating hydrazone **4b** for 2 h in acetic acid, pyrido[4,3-*d*]pyrimidine-2,4(1*H*,3*H*)-dione **5b** was isolated in 48% yield (Scheme 5).

Scheme 5



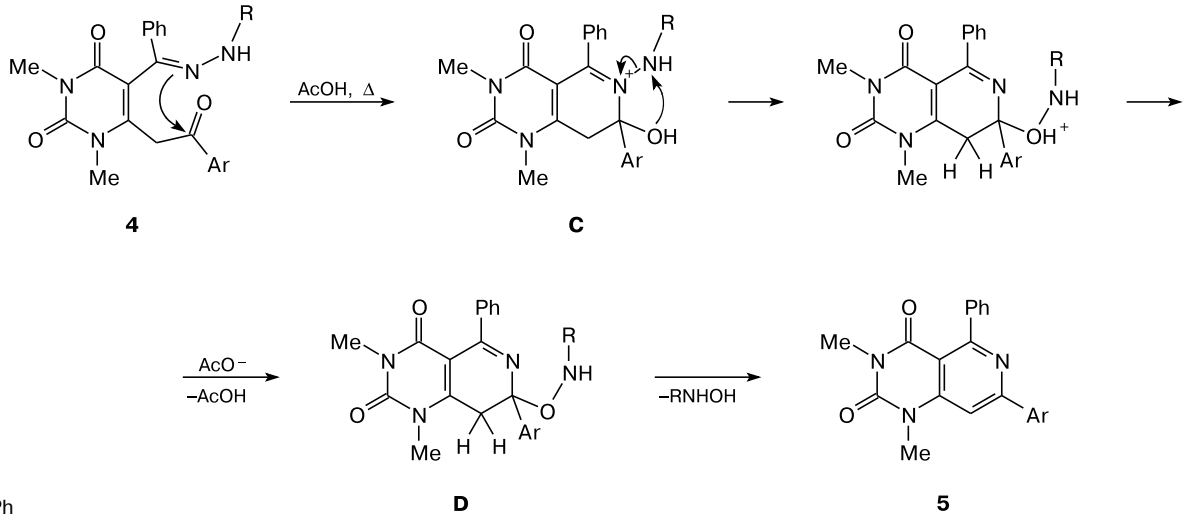
4b **5b**

Ar = 4-BrC_6H_4

Table 1. Main bond distances (*d*) and bond angles (ω) in independent molecules **A** and **B** of compound **4b**

Parameter	**A**	**B**
Bond	*d*/Å	
N(2)—C(7)	1.290(4)	1.283(4)
N(2)—N(4)	1.347(3)	1.347(3)
N(3)—C(3N)	1.470(4)	1.478(4)
N(4)—C(14)	1.393(4)	1.396(4)
C(4)—O(4)	1.217(3)	1.226(4)
C(4)—C(5)	1.459(4)	1.444(4)
C(5)—C(6)	1.352(4)	1.355(4)
C(5)—C(7)	1.503(4)	1.507(4)
C(6)—C(20)	1.514(4)	1.498(4)
C(7)—C(8)	1.474(4)	1.473(4)
C(20)—C(21)	1.527(4)	1.525(4)
C(21)—O(21)	1.213(3)	1.219(4)
Angle	ω/deg	
N(2)—C(7)—C(5)	122.5(3)	122.9(3)
N(2)—N(4)—C(14)	119.7(3)	120.6(3)
N(2)—C(7)—C(8)	117.5(3)	118.6(3)
C(4)—C(5)—C(7)	117.5(2)	116.1(3)
C(5)—C(6)—C(20)	121.4(3)	121.8(3)
C(6)—C(5)—C(7)	122.7(3)	122.8(3)
C(7)—N(2)—N(4)	119.6(2)	120.1(3)

Scheme 6

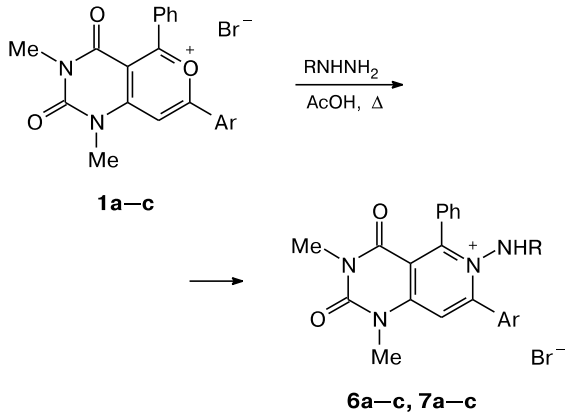


4 **C** **D** **5**

Probably, upon elevation of temperature hydrazone **4** undergoes cyclization due to the intramolecular attack by the hydrazone N atom on the C atom of the aroylmethyl group at the adjacent position of the uracil ring, which leads to the intermediate **C**. Further, the O atom of the hydroxy group intramolecularly attacks the N atom of the phenylamino group, as a result, the "aniline" fragment migrates to the hydroxyl to form compound **D**, which aromatizes to product **5** by elimination of phenylhydroxylamine (Scheme 6).

At the same time, the reactions of pyrimidopyrylium bromides **1** with *m*-carboxyphenylhydrazine and aroylhydrazines in boiling acetic acid lead to *N*-substituted derivatives of 6-(R-amino)-1,3-dimethyl-2,4-dioxo-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium **6a—c** and **7a—c** (Scheme 7).

Scheme 7



1a—c **6a—c, 7a—c**

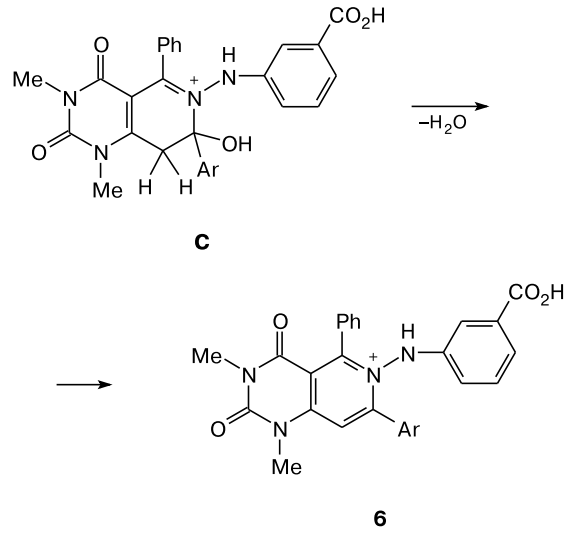
1, 6: Ar = Ph (**a**), 4-BrC_6H_4 (**b**), 4-$MeOC_6H_4$ (**c**);
6: R = 3-$CO_2HC_6H_4$;
7: Ar = Ph: R = PhCO (**a**), 4-ClC_6H_4CO (**b**), 4-$MeOC_6H_4CO$ (**c**)

The ^1H NMR spectra of compounds **6a—c** exhibit signals for the protons of three aromatic substituents, the singlet in the region δ 8.13—8.24 belonging to the CH proton of the pyridinium ring, as well as the signals for the NH proton at δ 10.11—10.16 and proton of the carboxy group in the region δ 11.40—13.80, which disappear on deuteration. The IR spectra of compounds **6a—c** contain the bands in the region 1675—1700 cm^{-1} and at 3270—3275 cm^{-1} related to the stretching vibrations of the carbonyl groups and NH group, respectively. In the ^1H NMR spectra of salts **7a—c**, there are also present the signals for the protons of three aromatic substituents and the signal for the NH proton of the aroylamide group at δ 12.05—13.87, disappearing on deuteration. In the IR spectra of compounds **7a—c**, there are observed the bands in the region 1620—1690 cm^{-1} corresponding to the stretching vibrations of the carbonyl groups, and a broad absorption band at 3406—3408 cm^{-1} related to the aroylamino group. The mass spectra of compounds **6a**, **7a**, and **7b** exhibit peaks corresponding to the fragmentation with the cleavage of the N—N bond.

The formation of pyridopyrimidium bromides **6** and **7** proceeds apparently also through the formation of the intermediate of the type **C**, which with participation of the substituent at the exocyclic atom N undergoes another transformations. For instance, the *m*-carboxyphenyl group promotes formation of poorly soluble pyridinium salts **6**, which immediately precipitates and does not undergo further transformations (Scheme 8).

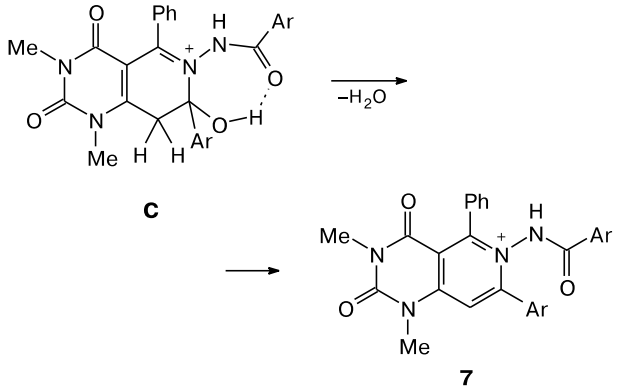
In the reaction of salts **1** with aromatic acid hydrazides due to the involvement of the carbonyl O atom of the aroyl group into the intramolecular hydrogen bond, the stabilization of the type **C** intermediate does not follow the mechanism given in Scheme 6, rather it is due to the elimina-

Scheme 8



tion of the water molecule to form *N*-aroylaminopyrimidopyridinium derivatives **7** (Scheme 9).

Scheme 9



In conclusion, we have shown that the reactions of bromides **1** with phenylhydrazine at room temperature lead to noncyclic hydrazones, whereas heating salts **1** with phenylhydrazines and aromatic acid hydrazides affords products of various structure, which depends on the nature of nucleophile. Mechanisms for the transformations observed have been suggested.

Experimental

IR spectra were recorded on a Specord IR-71 and Varian FT-IR 1000 spectrophotometers in Nujol. ^{1}H NMR spectra were recorded on a Bruker DPX-250 spectrometer in $CDCl_3$ or DMSO-d_6 with HMDS as an internal standard. Mass spectra were obtained on a Kratos instrument with direct injection of the sample in the source of irradiation (EI, 70 eV, directing voltage: 1.75 kV). Bromides **1** were synthesized according to the procedures described earlier.[2]

6-(2-Aryl-2-oxoethyl)-1,3-dimethyl-5-[phenyl(phenylhydrazono)methyl]pyrimidine-2,4(1*H*,3*H*)-diones 4 (general procedure). A suspension of salt **1** (0.5 mmol), phenylhydrazine (0.054 mL, 59.4 mg, 0.55 mmol), and triethylamine (0.077 mL, 55.6 mg, 0.55 mmol) in AcOH (2 mL) was stirred for 1 h at ~20 °C. The solvent was evaporated at ~20 °C (on a watch glass or in a porcelain dish), the oil formed was recrystallized using water. A precipitate was filtered off, washed with water and EtOH and dried at 80—100 °C.

1,3-Dimethyl-6-(2-oxo-2-phenylethyl)-5-[phenyl(phenylhydrazono)methyl]pyrimidine-2,4(1*H*,3*H*)-dione (4a). The yield was 160 mg (71%), pale yellow crystals, m.p. 145—148 °C (from EtOH). Found (%): C, 71.54; H, 5.29. $C_{27}H_{24}N_4O_3$. Calculated (%): C, 71.67; H, 5.35. ^{1}H NMR ($CDCl_3$), δ: 3.40, 3.44 (both s, 3 H each, N(1)Me, N(3)Me); 4.05 (d, 1 H, CH_2, J = 17.89 Hz); 4.29 (d, 1 H, CH_2, J = 17.89 Hz); 6.80 (t, 1 H, Ar, J = 7.19 Hz); 7.05 (d, 2 H, Ar, J = 7.37 Hz); 7.17 (t, 2 H, Ar, J = 7.90 Hz); 7.26—7.39 (m, 5 H, Ar); 7.53 (t, 1 H, Ar, J = 7.37 Hz); 7.62 (dd, 2 H, Ar, J_o = 8.07 Hz, J_m = 1.40 Hz); 7.69—7.78 (m, 3 H, Ar, NH). IR, ν/cm^{-1}: 1646, 1695 (C=O); 3299 (NH). MS, *m/z*: 452 $[M]^+$, 375 $[M - C_6H_5]^+$, 333 $[M - C_6H_5COCH_2]^+$, 92 $[C_6H_5NH]^+$, 77 $[C_6H_5]^+$.

6-[2-(4-Bromophenyl)-2-oxoethyl]-1,3-dimethyl-5-[phenyl(phenylhydrazono)methyl]pyrimidine-2,4(1*H*,3*H*)-dione (4b). The yield was 207 mg (78%), pale yellow crystals, m.p. 161—163 °C (from EtOH). Found (%): C, 60.82; H, 4.47; Br, 15.19. $C_{27}H_{23}BrN_4O_3$. Calculated (%): C, 61.03; H, 4.36; Br, 15.04. ^{1}H NMR ($CDCl_3$), δ: 3.40, 3.43 (both s, 3 H each, N(1)Me, N(3)Me); 4.03 (d, 1 H, CH_2, J = 17.89 Hz); 4.20 (d, 1 H, CH_2, J = 17.89 Hz); 6.80 (t, 1 H, Ar, J = 7.37 Hz); 7.01 (d, 1 H, Ar, J = 7.71 Hz); 7.16 (t, 1 H, Ar, J = 7.89 Hz); 7.26—7.37 (m, 3 H, Ar); 7.45 (d, 1 H, Ar, J = 8.41 Hz); 7.53 (d, 1 H, Ar, J = 8.77 Hz); 7.57—7.67 (m, 3 H, Ar, NH). IR, ν/cm^{-1}: 1651, 1700 (C=O); 3289 (NH).

1,3-Dimethyl-6-[2-(4-methoxyphenyl)-2-oxoethyl]-5-[phenyl(phenylhydrazono)methyl]pyrimidine-2,4(1*H*,3*H*)-dione (4c). The yield was 190 mg (79%), colorless crystals, m.p. 178—180 °C (from EtOH). Found (%): C, 69.86; H, 5.57. $C_{28}H_{26}N_4O_4$. Calculated (%): C, 69.70; H, 5.43. ^{1}H NMR ($CDCl_3$), δ: 3.42, 3.46 (both s, 3 H each, N(1)Me, N(3)Me); 3.82 (s, 3 H, OMe); 4.00 (d, 1 H, CH_2, J = 17.89 Hz); 4.27 (d, 1 H, CH_2, J = 17.89 Hz); 6.77—6.87 (m, 3 H, Ar); 7.10 (dd, 2 H, Ar, J_o = 8.60 Hz, J_m = 1.24 Hz); 7.20 (t, 2 H, Ar, J = 7.90 Hz); 7.29—7.41 (m, 3 H, Ar); 7.66 (dd, 2 H, Ar, J_o = 8.24 Hz, J_m = 1.58 Hz); 7.73 (d, 2 H, Ar, J = 8.77 Hz); 7.88 (s, 1 H, NH). IR, ν/cm^{-1}: 1657, 1713 (C=O); 3291 (NH).

7-Aryl-1,3-dimethyl-5-phenylpyrido[4,3-*d*]pyrimidine-2,4(1*H*,3*H*)-diones 5 (general procedure). A suspension of salt **1** (0.5 mmol) and phenylhydrazine (0.054 mL, 59.4 mg, 0.55 mmol) in AcOH (2 mL) was refluxed for 1—2 h. The reaction progress was monitored by TLC on Al_2O_3 (eluent, $CHCl_3$). The reaction solution was concentrated to dryness, a tar obtained was subjected to chromatography on Al_2O_3 (eluent, $CHCl_3$). The fraction, fluorescing blue under the UV light and being visualized as dark violet spots after treatment with iodine, was collected. The chloroform solution was concentrated, the forming reddish orange tar was rubbed with diethyl ether, the ether was decanted. The product was recrystallized from AcOH and dried at 100 °C.

1,3-Dimethyl-5,7-diphenylpyrido[4,3-*d*]pyrimidine-2,4(1*H*,3*H*)-dione (5a). The yield was 82 mg (48%), colorless crystals, m.p. 208—210 °C (from AcOH). Found (%): C, 73.68; H, 5.06. $C_{21}H_{17}N_3O_2$. Calculated (%): C, 73.45; H, 4.99. ^{1}H NMR ($CDCl_3$), δ: 3.38 (s, 3 H, N(3)Me); 3.71 (s, 3 H, N(1)Me); 7.41—7.54 (m, 9 H, Ar, C(8)H); 8.05—8.12 (m, 2 H, Ar). IR, ν/cm^{-1}: 1675, 1705 (C=O). MS, *m/z*: 343 $[M]^+$, 328 $[M - CH_3]^+$, 103 $[C_6H_5CN]^+$, 77 $[C_6H_5]^+$.

7-(4-Bromophenyl)-1,3-dimethyl-5-phenylpyrido[4,3-*d*]-pyrimidine-2,4(1*H*,3*H*)-dione (5b). The yield was 107 mg (51%), colorless crystals, m.p. 274—278 °C (from AcOH). Found (%): C, 59.80; H, 3.74; Br, 18.61. $C_{21}H_{16}BrN_3O_2$. Calculated (%): C, 59.73; H, 3.82; Br, 18.92. ^{1}H NMR ($CDCl_3$), δ: 3.38 (s, 3 H, N(3)Me); 3.71 (s, 3 H, N(1)Me); 7.41 (s, 1 H, C(8)H); 7.43—7.50 (m, 5 H, 5-Ar); 7.60 (d, 2 H, H(3′), H(5′), 7-Ar, *J* = 8.59 Hz); 7.98 (d, 2 H, H(2′), H(6′), 7-Ar, *J* = 8.77 Hz). IR, ν/cm^{-1}: 1665, 1700 (C=O).

1,3-Dimethyl-7-(4-methoxyphenyl)-5-phenylpyrido[4,3-*d*]-pyrimidine-2,4(1*H*,3*H*)-dione (5c). The yield was 80 mg (43%), colorless crystals, m.p. 236—239 °C (from AcOH). Found (%): C, 70.61; H, 5.19. $C_{22}H_{19}N_3O_3$. Calculated (%): C, 70.76; H, 5.13. ^{1}H NMR ($CDCl_3$), δ: 3.37 (s, 3 H, N(3)Me); 3.69 (s, 3 H, N(1)Me); 3.85 (s, 3 H, OMe); 6.97 (d, 2 H, H(3′), H(5′), 7-Ar, *J* = 9.12 Hz); 7.35 (s, 1 H, C(8)H); 7.41—7.53 (m, 5 H, 5-Ar); 8.07 (d, 2 H, H(2′), H(6′), 7-Ar, *J* = 8.77 Hz). IR, ν/cm^{-1}: 1660, 1690 (C=O).

7-Aryl-6-[(3-carboxyphenyl)amino]-1,3-dimethyl-2,4-dioxo-5-phenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromides 6 (general procedure). A suspension of salt **1** (0.5 mmol) and 3-carboxyphenylhydrazine (83.6 mg, 0.55 mmol) in AcOH (2 mL) was refluxed for 2 h. During the reflux, a colorless precipitate was formed, which was filtered off, washed with AcOH and $CHCl_3$ and dried at 100 °C.

6-[(3-Carboxyphenyl)amino]-1,3-dimethyl-2,4-dioxo-5,7-diphenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (6a). The yield was 210 mg (75.5%), colorless crystals, decomp. temperature >209 °C (from AcOH). Found (%): C, 60.33; H, 4.02; Br, 14.05. $C_{28}H_{23}BrN_4O_4$. Calculated (%): C, 60.12; H, 4.14; Br, 14.28. ^{1}H NMR (DMSO-d_6), δ: 3.16 (s, 3 H, N(3)Me); 3.75 (s, 3 H, N(1)Me); 6.35 (dd, 1 H, Ar, J_o = 8.07 Hz, J_m = 1.41 Hz); 6.65 (t, 1 H, Ar, *J* = 1.76 Hz); 6.90—7.21 (m, 4 H, Ar); 7.32—7.57 (m, 5 H, Ar); 7.67—7.77 (m, 3 H, Ar); 8.17 (s, 1 H, C(8)H); 10.11 (s, 1 H, NH); 12.41—13.31 (br.s, 1 H, CO_2H). IR, ν/cm^{-1}: 1675, 1700 (C=O); 3270 (NH). MS, *m/z*: 343 $[M - 3\text{-}CO_2H\text{—}C_6H_4NH]^+$, 137 $[3\text{-}CO_2H\text{—}C_6H_4NH]^+$, 81 $[Br]^+$, 79 $[Br]^+$, 77 $[C_6H_5]^+$.

7-(4-Bromophenyl)-6-[(3-carboxyphenyl)amino]-1,3-dimethyl-2,4-dioxo-5-phenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (6b). The yield was 254 mg (79.6%), colorless crystals, decomp. temperature >193 °C (from AcOH). Found (%): C, 52.86; H, 3.50; Br, 24.87. $C_{28}H_{22}Br_2N_4O_4$. Calculated (%): C, 52.69; H, 3.47; Br, 25.04. ^{1}H NMR (DMSO-d_6), δ: 3.19 (s, 3 H, N(3)Me); 3.77 (s, 3 H, N(1)Me); 6.39 (dd, 1 H, Ar, J_o = 8.07 Hz, J_m = 1.75 Hz); 6.69 (s, 1 H, Ar); 6.96 (d, 1 H, Ar, *J* = 7.72 Hz); 7.02—7.17 (m, 2 H, Ar); 7.24 (d, 1 H, Ar, *J* = 7.72 Hz); 7.40 (t, 1 H, Ar, *J* = 7.37 Hz); 7.56 (t, 1 H, Ar, *J* = 7.54 Hz); 7.68—7.78 (m, 5 H, Ar); 8.24 (s, 1 H, C(8)H); 10.16 (s, 1 H, NH); 11.75—13.49 (br.s, 1 H, CO_2H). IR, ν/cm^{-1}: 1680, 1700 (C=O); 3270 (NH).

6-[(3-Carboxyphenyl)amino]-1,3-dimethyl-7-(4-methoxyphenyl)-2,4-dioxo-5-phenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (6c). The yield was 161 mg (55%), colorless crystals, decomp. temperature >176 °C (from AcOH). Found (%): C, 59.32; H, 4.35; Br, 13.40. $C_{29}H_{25}BrN_4O_5$. Calculated (%): C, 59.09; H, 4.28; Br, 13.56. ^{1}H NMR (DMSO-d_6), δ: 3.18 (s, 3 H, N(3)Me); 3.77, 3.78 (both s, 3 H each, N(1)Me, OMe); 6.36 (dd, 1 H, Ar, J_o = 8.07 Hz, J_m = 1.76 Hz); 6.69 (s, 1 H, Ar); 6.93 (d, 1 H, Ar, *J* = 7.72 Hz); 6.99—7.16 (m + d, 4 H, Ar, H(3′), H(5′), 7-Ar, *J* = 9.12 Hz); 7.22 (d, 1 H, Ar, *J* = 7.72 Hz); 7.40 (t, 1 H, Ar, *J* = 7.37 Hz); 7.56 (t, 1 H, Ar, *J* = 7.72 Hz); 7.75 (d, 1 H, Ar, *J* = 8.07 Hz); 7.81 (d, 2 H, H(2′), H(6′), 7-Ar, *J* = = 8.77 Hz); 8.13 (s, 1 H, C(8)H); 10.15 (s, 1 H, NH); 11.40—13.80 (br.s, 1 H, CO_2H). IR, ν/cm^{-1}: 1690, 1700 (C=O); 3275 (NH).

6-Aroylamino-1,3-dimethyl-2,4-dioxo-5,7-diphenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromides 7 (general procedure). A suspension of salt **1** (0.5 mmol) and aroylhydrazine (0.55 mmol) in AcOH (2 mL) was refluxed for 0.5—2.0 h. The reaction progress was monitored by TLC on Al_2O_3 (eluent, $CHCl_3$). The mixture was concentrated cold and rubbed with diethyl ether. The product was recrystallized from suitable solvent and dried at 100 °C.

6-Benzoylamino-1,3-dimethyl-2,4-dioxo-5,7-diphenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (7a). The yield was 204 mg (75%), colorless crystals, m.p. 208—211 °C (from AcOH). Found (%): C, 62.01; H, 4.18; Br, 14.46. $C_{28}H_{23}BrN_4O_3$. Calculated (%): C, 61.89; H, 4.27; Br, 14.70. ^{1}H NMR ($CDCl_3$), δ: 3.35 (s, 3 H, N(3)Me); 3.80 (s, 3 H, N(1)Me); 7.14—7.23 (m, 3 H, Ar); 7.26—7.33 (m, 1 H, Ar); 7.34—7.47 (m, 7 H, Ar); 7.53—7.60 (m, 2 H, Ar); 8.02—8.12 (m, 2 H, Ar); 8.28 (d, 1 H, Ar, *J* = 7.75 Hz). IR, ν/cm^{-1}: 1620, 1687 (C=O); 3408 (NH). MS, *m/z*: 462 $[M - Br - H]^+$, 385 $[M - Br - H - C_6H_5]^+$, 343 $[M - Br - C_6H_5NHCO]^+$, 119 $[C_6H_5NCO]^+$, 77 $[C_6H_5]^+$.

6-[(4-Chlorobenzoyl)amino]-1,3-dimethyl-2,4-dioxo-5,7-diphenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (7b). The yield was 256 mg (89%), colorless crystals, m.p. 213—217 °C (from AcOH). Found (%): C, 58.42; H, 3.95; Br + Cl, 19.63. $C_{28}H_{22}BrClN_4O_3$. Calculated (%): C, 58.20; H, 3.84; Br + Cl, 19.97. ^{1}H NMR ($CDCl_3$), δ: 3.36 (s, 3 H, N(3)Me); 3.80 (s, 3 H, N(1)Me); 7.10—7.22 (m, 3 H, Ar); 7.29 (dd, 1 H, Ar, J_o = 7.72 Hz, J_m = 1.05 Hz); 7.35—7.50 (m, 6 H, Ar); 7.53—7.62 (m, 2 H, Ar); 7.99—8.11 (m, 2 H, Ar); 8.25 (d, 1 H, Ar, *J* = 7.72 Hz); 12.05—13.87 (br.s, 1 H, NH). IR, ν/cm^{-1}: 1620, 1690 (C=O); 3406 (NH). MS, *m/z*: 497 $[M]^+$, 343 $[M - 4\text{-}ClC_6H_5NHCO]^+$, 153 $[4\text{-}ClC_6H_5NCO]^+$.

1,3-Dimethyl-6-[(4-methoxybenzoyl)amino]-2,4-dioxo-5,7-diphenyl-1*H*,3*H*-pyrido[4,3-*d*]pyrimidinium bromide (7c). For purification, a suspension of the compound in benzene was three times refluxed and filtered hot. The yield was 194 mg (68%), colorless crystals, m.p. 212—216 °C (from benzene). Found (%): C, 60.56; H, 4.31; Br, 14.08. $C_{29}H_{25}BrN_4O_4$. Calculated (%): C, 60.74; H, 4.39; Br, 13.93. ^{1}H NMR ($CDCl_3$), δ: 3.39 (s, 3 H, N(3)Me); 3.74, 3.83 (both s, 3 H each, N(1)Me, OMe); 6.71 (d, 2 H, H(3″), H(5″), 6-Ar, *J* = 9.12 Hz); 7.19 (d, 1 H, Ar, *J* = 7.71 Hz); 7.32 (d, 1 H, Ar, *J* = 7.36 Hz); 7.41—7.52 (m, 6 H, Ar); 7.56—7.66 (m, 2 H, Ar); 8.07—8.16 (m, 2 H, Ar); 8.31 (d, 1 H, Ar, *J* = 8.06 Hz); 12.53—13.09 (br.s, 1 H, NH). IR, ν/cm^{-1}: 1620, 1687 (C=O); 3408 (NH).

X-ray diffraction study of compound 4b. Monocrystals of compound **4b** were obtained by crystallization from EtOH. Crystals **4b** ($C_{28}H_{26}BrN_4O_{3.50}$) are triclinic, M = 554.44, the space group is *P*-1, at 120 K *a* = 11.6260(6) Å, *b* = 14.5900(7) Å, *c* = 17.0219(9) Å, α = 66.601(1)°, β = 88.501(1)°, γ = 77.87(1)°, *V* = 2585.6(2) Å^3, *Z* = 4 (*Z′* = 2), μ(Mo-Kα) = 1.63 mm^{-1}, *F*(000) = 1140. Intensities of 23078 reflections were measured

on a Bruker SMART 1000 CCD diffractometer (λ(Mo-Kα) = = 0.71072 Å, ω-scanning, 2θ < 52°), 10162 of independent reflections (R_{int} = 0.0356) were used in further refinement. The structure was solved by the direct method and refined by the full-matrix least-squares method on F^2 with anisotropic thermal parameters for all the nonhydrogen atoms. Positions of the hydrogen atoms of the amino groups in two independent molecules **A** and **B** were localized from differential Fourier-syntheses of electron density and refined in isotropical approximation, whereas on carbon atoms, they were calculated geometrically and refined using the riding model. The final values of nonconfidence factors for **4b**: wR_2 = 0.1185, GOF = 1.030 for all the independent reflections (R_1 = 0.044, calculated on F for 7573 observed reflections with $I > 2\sigma(I)$). All the calculations were performed using the SHELXTL PLUS 5.10 program package.

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