INVESTIGATION OF MACROCYCLIC COMPOUNDS FORMED IN THE TEMPLATE SELF-CYCLIZATION OF DERIVATIVES OF 5-AMINO-4-[(2-HALOPHENYL)AZO]PYRAZOLES

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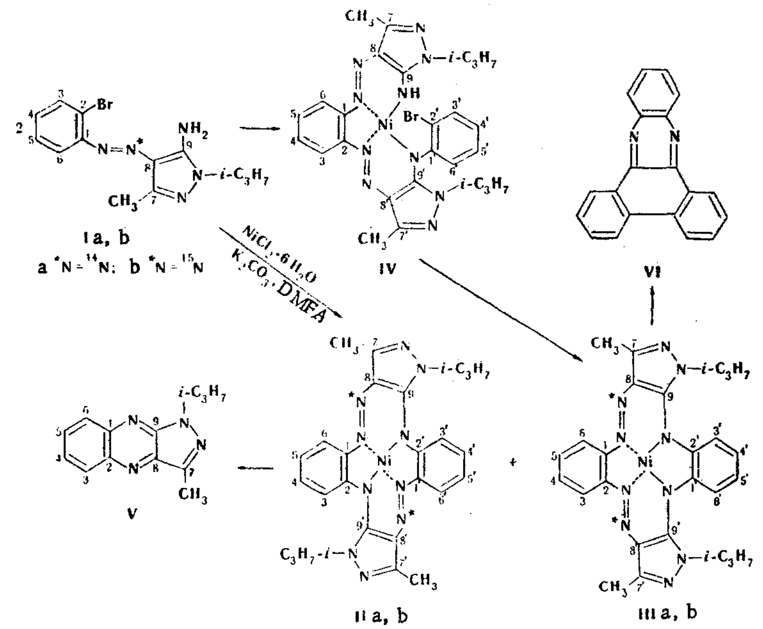
When the template self-cyclization of 5-amino-4-[(2-bromophenyl)azo]-3-methyl-1-isopropylpyrazole (Ia) is carried out according to the method in [1], a significant amount of a less soluble isomer forms along with the expected 1,10,11,20-tetrahydrodibenzo[c,j]dipyrazolo[3,4-f; 3',4'-m] [1,2,5,8,9,12]hexaazocyclotetradecene derivative. In order to refine the structures of the macrocyclic compounds obtained, we carried out this synthesis by starting out with compound Ib, which contains the ^{15}N isotope in the pyrazole ring.

Compounds II and III were isolated. When the reaction was carried out with pyrazole Ia in DMSO, we observed the predominant formation of IIIa, and when the temperature was lowered, we observed the formation of the intermediate o-bisazo compound IV, which cyclized to form IIIa upon heating to a higher temperature. After the oxidation of the products of the reductive cleavage of IIa, we isolated compound V, which apparently formed as a result of the oxidative cyclization of 4-amino-5-[(2-aminophenyl)amino]-3-methyl-1-isopropylpyrazole. The reductive cleavage of IIIa resulted in the formation of o-phenylenediamine, which was isolated in the form of derivative VI.



The structures of compounds I-V are confirmed by their ^{1}H and ^{13}C NMR spectra. The assignment of the AA'BB' systems in the PMR spectra of compounds III and IV was made by the method of double homonuclear resonance. Both AA'BB' systems for the signals of the aromatic protons in compound III were calculated ac-

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TABLE 1. PMR Spectra of Compounds I–V (chemical shifts σ in ppm relative to TMS, $CDCl_3$, 30°C)

Protons	I[a]	II[b]	III[d]	IV[e]	V
CH_3 (*i*-Pr)	1,37 d	1,01 d 1,54 d[c]	1,01 d 1,57 d	1,02 d, 1,08 d 1,14 d, 1,15 d	1,64 d
CH_3 (Pyr)	2,46 s	2,33 s	2,38 s	2,35 s., 2,44 s	2,81 s
CH (*i*-Pr)	4,06 sep	4,36 sep	4,47 sep	3,02 sep, 3,20 sep	5,31 m
3-H	7,59	6,57—6,85 m	7,51	8,04—8,16 m	8,16 m
4-H	7,26		6,82	7,02—7,20 m	7,70 m
5-H	7,03		6,82	7,02—7,20 m	7,70 m
6-H	7,75	7,76 q	7,51	8,04—8,16 m	8,16 m
3-H′		6,57—6,85 m	6,68	7,73	
4-H′			7,00	7,30—7,45 m	
5-H′			7,00		
6-H′		7,76 q	6,68		

[a]Signal of protons of an NH_2 group at 6.44 ppm. [b]In a CCl_4 solution. [c]The two doublets merge into one at 54°C [1]. [d]The chemical shifts of the aromatic protons were calculated according to spin simulation program on a Varian 620-L mini computer. [e]Signal of the proton of an NH group at 2.82 ppm.

cording to the spin simulation program on a Varian Data-620-L mini computer (Table 1) with the following parameters: $J_{34} = J_{56} = 7.8$, $J_{35} = J_{46} = 1.5$, $J_{45} = 0.3$, $J_{3'4'} = J_{5'6'} = 7.5$, $J_{3'5'} = J_{4'6'} = 1.6$, $J_{4'5'} = 0$ Hz.*

The magnetic equivalence of the protons and of the carbon nuclei of the pyrazole rings in the spectra of compounds II and III confirms the existence of a symmetry plane in the molecules of these compounds. As a result of the slowed rotation of the isopropyl groups, the spectra of these compounds each show two doublets of methyl protons and two signals of the carbon nuclei, while the spectrum of compound IV shows four doublets of the protons and four carbon signals of the methyl groups due to the additional inequivalence of the pyrazole rings.

The structure of the chelate rings in compounds II and III was established on the basis of an analysis of the absolute values of the spin–spin coupling constants $J_{^{13}C-^{15}N}$ in the ^{13}C NMR spectra of the compounds, which were labeled with the ^{15}N isotope. The fact that the spin–spin coupling constants of ^{13}C and ^{15}N nuclei through the same number of bonds are determined by the spatial proximity of the particular ^{13}C atom to the lone pair of the ^{15}N atom [2] was utilized in the conformational assignment.

The closeness of the chemical shifts and the values of the spin–spin coupling constant $J_{^{13}C-^{15}N}$ for the equivalent carbon atoms (7–7′, 8–8′, and 9–9′) in the spectra of compounds IIb and IIIb (Table 2) points out the identical orientations of the lone pairs of the ^{15}N atoms in these compounds relative to the pyrazole ring.

An examination of the theoretically possible configurations of the chelate rings in compounds II and III makes it possible to eliminate: 1) the migration of a ^{15}N atom from the α position to a pyrazole in the azo bond and 2) the possibility of the formation of a five-membered metal-containing chelate ring on a pyrazole ring rather than a benzene or a six-membered metal-containing chelate ring on a benzene ring rather than on a pyrazole.

For example, in the case of the migration of a ^{15}N atom in compound II from the α to the β position relative to a pyrazole ring in an azo bond (this migration would have to take place in both azo bonds in order not to destroy the equivalence of the signals of the carbon atoms of the benzene and pyrazole rings when they interact with the ^{15}N nuclei), replacement of the spin–spin coupling constants for the C_2 atom ($^3J_{\text{cis-trans}}$ by $^3J_{\text{cis-cis}}$) for the C_7 atom ($^2J_{\text{cis}}$ by $^2J_{\text{trans}}$), and for the C_9 atom ($^2J_{\text{trans}}$ by $^2J_{\text{cis}}$) should have been expected. The last two changes in practice would mean the reversal of the assignment of the signals of the C_7 and C_9 atoms in the ^{13}C NMR spectrum of compound II. However, the assignment of the signal of the C_7 atom is confirmed by the Overhauser effect when the protons of the methyl group on the C_7 atom in these compounds are selectively irradiated. The formation of a five-membered metal-containing chelate ring on a pyrazole ring and of a six-membered ring on a benzene ring in compound II would have resulted in the replacement of the spin–spin coupling constants for the C_1 atom ($^2J_{\text{cis}}$ by ^1J), for the C_2 atom ($^3J_{\text{cis-trans}}$ by $^2J_{\text{cis}}$), and for the C_6 atom ($^3J_{\text{cis-cis}}$

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*Here and in the following the numbering of the atoms which is convenient for the interpretation of the NMR spectra is given.

TABLE 2. Carbon-13 NMR Spectra of Compounds I–V (chemical shifts σ in ppm relative to TMS, $CDCl_3$, 30°C)[a]

Carbon atoms	I	II	III	IV	V
CH_3 (Pyr)	11,16	12,37	12,36	11,86 12,12	11,78
CH_3 (*i*-Pr)	20,92	18,90 22,01	18,93 22,35	20,70 20,95 21,69 22,12	21,92
CH (*i*-Pr)	47,44	51,34	51,36	47,08 49,52	48,76
C_1	149,60	148,65	142,46	145,01	130,43
C_2	123,03	142,76	142,46	144,76	130,43
C_3	132,91	122,97[b]	115,34	115,67	128,66
C_4	127,91	125,57[b]	127,06	125,44	127,13
C_5	128,74	117,51	127,06	125,89	127,13
C_6	116,70	115,74	115,34	116,00	128,66
C_7	148,48	149,97	149,68		141,92
C_8	124,62	136,29	134,57	129,96[c]	136,86
C_9	137,81	138,84	138,49		140,93
$C_{1'}$		148,65	143,08	146,50[c]	
$C_{2'}$		142,76	143,08	124,00	
$C_{3'}$		122,97[b]	121,63	133,44	
$C_{4'}$		115,74	121,63	127,87	
$C_{5'}$		125,57[b]	117,42	128,42	
$C_{6'}$		117,51	117,42	129,43	
$C_{7'}$		149,97	149,68	147,05	
$C_{8'}$		136,29	134,57	135,83	
$C_{9'}$		138,84	138,49	137,71	

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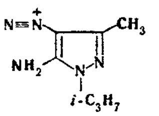
[a] Values of $J_{^{13}C-^{15}N}$ in Hz. For Ib: C_1, $^2J = 6.0$; C_2, $^3J = 3.1$; C_6, $^3J = 5.3$; C_7, $^2J = 7.7$; C_8, $^1J = 1.9$. For IIb: $C_{1(1')}$, $^2J = 6.0$; $C_{2(2')}$, $^3J = 2.2$; $C_{6(6')}$, $^3J = 4.2$; $C_{7(7')}$, $^3J = 8.3$; $C_{8(8')}$, $J = 4.7$; $C_{9(9')}$, $^2J = 0.9$. For IIIb: $C_{1(2)}$, $^2J = 6.2$; $^3J = 1.9$; $C_{3(6)}$, $^3J = 4.3$; $C_{7(7')}$, $^2J = 8.4$; $C_{8(8')}$, $^1J = 4.8$; $C_{9(9')}$, $^2J = 0.8$. [b] The assignment of the signals of these pairs of carbon atoms may be the reverse. [c] The signals of these carbon atoms are superimposed on other more intense signals.

by $^2J_{trans}$) and the appearance of $^3J_{cis-trans}$ for C_3 and $^3J_{trans-trans}$ for C_5. The changes in the spin–spin coupling constants for the C_6 and C_3 atoms in practice mean the reversal of the assignment of the signals of the C_6 and C_3 atoms in the ^{13}C NMR spectrum of compound II. However, the assignment of the signal of the C_6 atom was confirmed by $^{13}C-\{H\}$ selective double resonance.

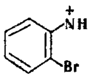
The extent of enrichment and the position of the ^{15}N isotope in the compound Ib were verified by mass spectrometry. The mass spectrum of compound Ia shows an intense peak of the molecular ions and peaks of the following fragments:

$[M-Br]^+$

(a)



(b)



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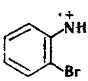
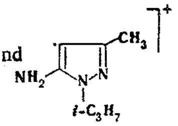


(d)

and



(f)

In the mass spectrum of compound Ib the value of m/e of the molecular ion and some of the fragmentary ions was increased by unity, attesting to the presence in the molecule of one ^{15}N atom. The enrichment of the molecular and fragment ions with the ^{15}N isotope was calculated from the formula

$$\delta = \frac{I_{n+1} - \alpha_n I_n}{I_n + (I_{n+1} - \alpha_n I_n)} \cdot 100.$$

After dividing by I_n and setting I_{n+1}/I_n equal to β_n, we have the equivalent formula

$$\delta = \frac{\beta_n - \alpha_n}{1 + (\beta_n - \alpha_n)} \cdot 100.$$

TABLE 3. Yields and Constants of Compounds I–V

Compound	mp, °C	λ_{max}, nm (log ε) in hexane	Found, %				Empirical formula	Calculated, %				*M*		Yield, %
			C	H	N	Ni		C	H	N	Ni	found*	calc.	
I	140—141	234 (3,95), 251 (3,86), 258 sh (3,77), 329 (3,91), 377 sh (4,22), 389 (4,26), 406 sh (4,18)	48,42	5,06	21,84		$C_{13}H_{16}BrN_4{}^{15}N$	48,31	4,99	21,98		322	323,21	79,49
II	288—289	234 (4,47), 259 (4,46), 276 (4,51), 292 (4,48), 314sh (4,08), 327 sh (4,02), 388 sh (4,18), 411 (4,21), 457 (4,49), 465 sh (4,47), 589sh (3,55), 627 (3,72)	57,83	5,16	26,10	10,93	$C_{26}H_{28}N_8{}^{15}N_2Ni$	57,69	5,21	26,25	10,85	540	541,29	35,93
III	above 305	241 (4,52), 267 (4,53), 289 (4,48), 336 (4,13), 359 (4,20), 405 (4,14), 457 (4,43), 469 sh (4,43), 571 sh (3,62), 605 (3,77)	57,81	5,21	26,12	10,98	$C_{26}H_{28}N_8{}^{15}N_2Ni$	57,69	5,21	26,25	10,85	540	541,29	37,5
IV	266—266,5	251 (4,49), 274 sh (4,34), 330 (4,16), 411 sh (4,35), 420 sh (4,37), 425 (4,37), 458 sh (4,12), 504 (4,02), 547 sh (3,70)	50,30	4,56	22,69	9,65	$C_{26}H_{29}BrN_{10}Ni$	50,35	4,71	22,58	9,46	618	620,21	13,6
V	104—104,5	243 sh (4,69), 245 (4,71), 316 sh (3,82), 322 (3,93), 329 (4,02), 333 sh (3,96), 371 sh (3,49), 381 sh (3,58), 389 (3,64), 398 (3,69), 409 (3,62), 420 (3,54)	68,89	6,34	24,73		$C_{13}H_{14}N_4$	69,00	6,24	24,76		226	226,28	40

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*The molecular weights were found by mass spectrometry.

Here δ is the relative concentration of the molecules (fragments) containing ^{15}N; I_n and I_{n+1} are the intensities of the n-th and (n+1)-th ion peaks in the spectrum of the labeled compound Ib;

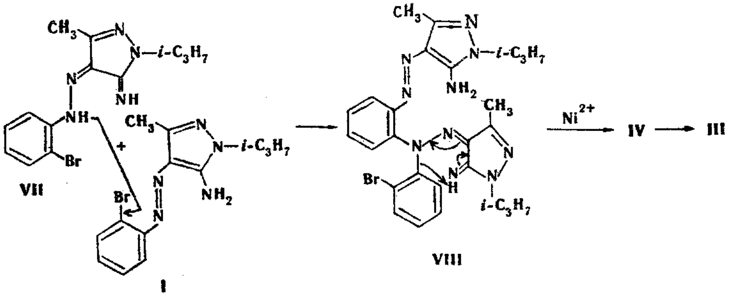
$$\alpha_n = \frac{I'_{n+1}}{I'_n} - m \cdot 0.004,$$

where I'_n and I'_{n+1} are the intensities of the n-th and (n+1)-th peaks in the spectrum of the unlabeled compounds Ia; m is the number of nitrogen atoms for the particular fragment (0.004 is the natural abundance of the ^{15}N isotope).

The relative concentration of molecules containing the ^{15}N isotope calculated from the peaks of the molecular and fragment ions (a and b) was 96.3%. The enrichment of fragments c and d with the ^{15}N isotope amounted to only ~5%, and fragment f did not contain the ^{15}N isotope. On the basis of these findings we may state that practically all the ^{15}N atoms (94.5%) were in the α position relative to a pyrazole ring.

It was demonstrated mass-spectrometrically that the two main compounds, viz., II and III, isolated after the cyclization reaction are isomers. The mass spectrum of trans isomer II contained intense peaks of the molecular and fragment ions formed as a result of the removal of one or two alkene molecules from the isopropyl substituents: $[M-C_3H_6]^+$ and $[M-2C_3H_6]^+$. The mass spectrum of cis isomer III was similar to that indicated, but the probability of the splitting off of the substituents in this case was 1.34 times higher.

The data obtained suggest that in the template self-cyclization of o-halo-o'-aminoazo compounds under study, along with the nucleophilic substitution of the halogens by arylamino groups, which produces an isomer of type II, there takes place a nucleophilic attack by the secondary nitrogen of iminohydrazone species VII on the ortho carbon atom azoamino species I to form reaction product VIII, which, in turn, undergoes a further cyclic rearrangement accompanied by migration of the o-bromophenyl, is stabilized in the form of chelate IV, and is then cyclized to compound III.



EXPERIMENTAL

The NMR spectra were recorded on a Varian XL-100-12 at 30°C in a 0.15 M solution in CCl_4 and $CDCl_3$ (the internal reference was TMS). The electronic spectra were recorded on a Shimadzu MPS-50L spectrophotometer with the use of 2×10^{-4}-2×10^{-5} M solutions in hexane in quartz cuvettes (d = 10 mm). The IR spectra were recorded on a UR-20 spectrophotometer in CS_2 (< 1400-cm^{-1} region) and C_2Cl_4 (> 1400-cm^{-1} region) at concentrations equal to 1.4×10^{-2} to 2.1×10^{-2} M in NaCl cuvettes (d = 1 mm). The mass spectra were recorded on an AEIMS-702 mass spectrometer with the use of a source with direct introduction of the sample into the ionization region, an accelerating voltage of 8 kV, an energy of the ionizing electrons equal to 70 eV, and a temperature for evaporation of the samples equal to 100-180°C.

5-Amino-4-[(2-bromophenyl)azo(N, ^{15}N)]-3-methyl-1-isopropylpyrazole (Ib). A solution of 4.6 g (0.027 mole) of o-bromoaniline in 108 ml of water and 5.4 ml of 35% hydrochloric acid was given an addition with stirring and cooling to 0°C of a solution of 1.9 g (0.027 mole) of sodium nitrite ($Na^{15}NO_2$) in 7 ml of water. The mixture was stirred for an additional 30 min at 0°C. The solution of the diazo compound obtained was added to a solution of 3.7 g (0.027 mole) of 5-amino-1-isopropyl-3-methylpyrazole [3] in 14.5 ml of acetic acid, which had been cooled to 13-15°C, and held for 6 h (pH 4-5). The precipitate formed was filtered, washed with water, dried, and recrystallized from cyclohexane. The yield was 6.9 g of yellowish orange plates. IR spectrum: $\nu_{asym}(NH_2)$ 3462,* $\nu_{sym}(NH_2)$ 3275,* $\nu_{asym}(CH_3)$ 2988, $\nu_{C=C/N=N}$ 1613, 1487, 1463, $\delta_{sym}(CH_3)$ 1383, δ(CH), 1115, 1027, γ(CH) 755 cm^{-1}.

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*The bands of the stretching vibrations of the NH_2 group were measured at a concentration of 3×10^{-4} mole/liter in cuvettes (d = 100 mm).

(1,10,11,20-Tetrahydro-3,13-dimethyl-1,11-diisopropyldibenzo[c, j]dipyrazolo[3,4-f; 3',4'-m] [1,2,5,8,9,12]hexaaza[$^{15}N^1$, $^{15}N^8$]cyclotetradecenato-(2^-)-N^5, N^{10}, N^{15}, N^{20})nickel (II) and (1,14,15,20-Tetrahydro-3,12-dimethyl-1,14-diisopropyldibenzo[c,j]dipyrazolo[3,4-f; 3'4'-m] [1,2,5,6,9,12]hexaaza[$^{15}N^1$, $^{15}N^6$]cyclotetradecenato-(2^-)-N^5, N^{10}, N^{15}, N^{20})nickel (III). A. A mixture of 0.76 g (2.4 mmole) of I, 0.67 g (2.9 mmole) of nickel (II) chloride hexahydrate, 2.0 g (15 mmole) of potassium carbonate, and 60 ml of DMFA was boiled for 6 h. The mixture was filtered after cooling, and the precipitate (A) was washed on the filter with DMFA to weak coloration of the filtrate (B) and then with hot water to the complete removal of K_2CO_3, dried, and recrystallized from m-xylene. This yielded 0.24 g of dark green fine needles of IIIb. IR spectrum: $\nu_{asym}(CH_3)$ 2979, $\nu_{C=C/N=N}$ 1586, 1557, 1495, 1479, 1443, $\delta_{sym}(CH_3)$ 1386, δ(CH) 1123, 1109, 1026, γ(CH) 749.

The filtrate (B) was diluted with 70 ml of water, boiled, cooled, and filtered, and the precipitate on the filter was washed with a small amount of aqueous DMFA (1:1) and then with water and dried. The dry product was dissolved in 5 ml of benzene and purified in a chromatographic column filled with neutral Al_2O_3 of the second activity grade (the eluent was benzene). The product was recrystallized from a 1:15 mixture of benzene and methanol. This yielded 0.23 g of almost black crystals with a green glitter of compound IIb. IR spectrum $\nu_{asym}(CH_3)$ 2981, $\nu_{C=C/N=N}$ 1584, 1557, 1487, 1464, 1442, $\delta_{sym}(CH_3)$ 1386, δ 1123, 1110, 1028, γ(CH) 751 cm^{-1}

B. When the reaction was carried out in 70 ml of DMSO at a temperature of 170°C over the course of 6 h, only compound III was obtained. The yield was 0.19 g (30%).

(4-[[2-[(5-Amino-3-methyl-1-isopropylpyrazol-4-yl)azophenyl]azo]-5-[(2-bromophenyl)amino]-3-methyl-1-isopropylpyrazolato(2^-)-N,N,N,N])nickel (IV). Compound IV was obtained in analogy to compound II with heating to 135°C for 6 h. The treatment of the reaction mass was similar. The dry precipitate was dissolved in 5 ml of benzene and purified with the aid of a chromatographic column in silica gel (from Chemapol, λ 100/160 μ, the eluent was benzene). A fraction (A) containing mainly compound II, then a fraction (B) containing compounds IV and II, and a fraction (C) containing compound IV were isolated. Benzene was distilled off from fraction A, and the dry residue was dissolved in 10 ml of 35% hydrochloric acid, diluted with 100 ml of water, and boiled. The mixture was cooled and filtered, and the precipitate on the filter was washed with water, dried, and recrystallized from a 1:20 benzene–methanol mixture. This yielded 0.14 g (22.5%) of compound II, mp 288-289°C Fraction B was evaporated to dryness, and the residue was recrystallized from 10 ml of glacial acetic acid. The precipitate was filtered, washed with acetic acid then with water, and dried. Recrystallization from a 1:20 benzene–methanol mixture yielded 0.06 g of IV. Fraction C was concentrated to 3 ml, 60 ml of methanol were added, and another 0.04 g of IV was obtained. The mass spectrum showed peaks of the molecular ions, whose intensity distribution could be used to evaluate the presence in the molecule of nickel and bromine atoms. IR spectrum: ν(NH) 3366, $\nu_{asym}(CH_3)$ 2975, $\nu_{C=C/N=N}$ 1604, 1565, 1519, 1494, 1461, $\delta_{sym}(CH_3)$ 1385, δ(CH) 1119, 1111, 1027, γ(CH) 747 cm^{-1}

Synthesis of III by Cyclization of IV. A solution of 0.5 g (0.8 mmole) of IV in 50 ml of DMFA was boiled in the presence of 2 g (14.4 mmole) of K_2CO_3 for 5 h. The cooled reaction mixture was filtered, and the precipitate on the filter was washed with water and dried. Recrystallization from m-xylene yielded 0.39 g (75%).

3-Methyl-1-isopropyl-1H-pyrazolo[3,4-b]quinoxaline (V). A 1.0-g portion (1.8 mmole) of compound II was given an addition of 0.5 g (4.2 mmole) ammonium metavanadate, which had been dissolved in 75 ml of 35% hydrochloric acid and reduced to vanadium (II) with metallic zinc, and held for 0.5 h with stirring. The reaction mixture was filtered, concentrated to 50 ml, given an addition of several drops of a 50% $FeCl_3$ solution, heated to boiling, and left to stand overnight. Fine dirty-yellow needles with mp 101-102°C (from aqueous ethanol) were precipitated from the solution. Repeated purification in a chromatographic column filled with Al_2O_3 of the second activity grade (the eluent was benzene) and recrystallization from 1:4 aqueous ethanol yielded 0.4 g of yellow needles. The structure of compound V was established on the basis of the NMR and mass spectra. IR spectrum: $\nu_{asym}(CH_3)$ 2983, $\nu_{C=C/N=N}$ 1579, 1511, 1484, 1457, $\delta_{sym}(CH_3)$ 1386, δ(CH) 1129, 1109, 1055, γ(CH) 756 cm^{-1}.

Dibenzo[a, c]phenazine (VI). Compound VI was synthesized in analogy to compound V by reducing compound III. The filtrate was neutralized with a 50% KOH solution to pH 4-5. The precipitate formed was filtered, the filtrate was extracted several times with chloroform, then the chloroform was driven off, and the residue was dissolved in 20-25 ml of 50% ethanol, given an addition of 5-6 drops of a solution of phenanthrenequinone in glacial acetic acid, and boiled. Fine crystals were precipitated from the solution, filtered, washed with water, and dried. The product was recrystallized from ethanol in the form of yellow needles with mp 217-218°C. A mixed sample of VI with a known specimen obtained according to [4] did not display melting-point depression. The compound was identified mass-spectrometrically.

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SYNTHESIS AND SOME PROPERTIES OF TETRAHYDROQUINAZOLINE 1,3-DIOXIDES

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UDC 543.422.25.4.6:547.856.1

It has previously been established that 1,3-dioxides of pyrimidines form as a result of the oxidation of products of the condensation of 1,3-hydroxylaminooximes with aldehydes [1]. In the present work this method was used for the synthesis of condensed pyrimidine 1,3-dioxides, viz., 5,6,7,8-tetrahydroquinazoline 1,3-dioxides, for which there is no information in the literature.

For this purpose we carried out the condensation of N-[(1-hydroxyiminocyclohex-2-yl)methyl]hydroxylamine (I) with carbonyl compounds [2]. The reaction of 1,3-hydroxylaminooxime I with formaldehyde, acetaldehyde, and acetone yielded condensation products (II-IV) with the splitting off of a water molecule. The PMR spectra of compounds II-IV point out that the condensation product with formaldehyde has the structure of 3-hydroxy-2,3,4,4a,5,6,7,8-octahydroquinazoline 1-oxide (cyclic form IIB), that with acetone is N-[(1-hydroxyiminocyclohex-2-yl)methyl]-α,α-dimethylnitrone (open form IVA), and the condensation product with acetaldehyde exists in a tautomeric mixture of open and cyclic forms (IIIA $\rightleftharpoons$ IIIB). Thus, the PMR spectrum of IIB in pyridine shows a broadened singlet of the protons of the methylene group in position 2 of the heterocycle at 4.92 ppm, and there are no signals (in D_2O) of the protons of the methylenenitrone group of open form IIA in the 6.0-7.0-ppm region [3]. The PMR spectrum of derivative IVA in D_2O has two signals of the protons of the methyl groups in the α,α-dimethylnitrone configuration at 2.10 and 2.19 ppm and does not show any signals of the protons in the geminal methyl groups of cyclic form IVB in the 1.4-1.7-ppm region [2, 4]. The PMR spectrum of compound III in D_2O shows a doublet of the protons of the methyl group and a quartet of the methine proton of the α-methylnitrone configuration of open form IIIA at 1.96 and 7.25 ppm ($J = 6.0$ Hz), respectively, whereas for cyclic form III there are two doublets of the protons of the methyl group in position 2 of the heterocycle: 1.49 ($J = 6.5$ Hz) and 1.53 ppm ($J = 6.5$ Hz) with a ~1:6 ratio. This points out the presence in the solution of two cyclic tautomeric forms, which are distinguished by the cis and trans orientations of the substituents in positions 2 and 4a of the heterocycle [5]. The constant of the tautomeric equilibrium ($K_T = [A]/[B]$) for III in D_2O is equal to 0.6, and that in pyridine is equal to 2.2.

It is noteworthy that the presence of a cyclohexane ring in 1,3-hydroxylaminooxime I caused an increase in the relative concentration of cyclic tautomer IIIB in the condensation product of III in comparison to the condensation product of the acyclic 1,3-hydroxylaminooxime which contains two methyl groups instead of the tetramethylene bridge (compare [2]).

Along with the bands at 1629 and 1623 cm^{-1}, which fit the stretching vibrations of the C=N bond in nitrones [6], the IR spectra (in KBr) of III and IV show bands at 1659 and 1657 cm^{-1}, respectively, of the stretching vibrations of a C=N bond in oximes [7], confirming structure IVA and suggesting that compound III also exists in open form IIIA in the crystalline state.

It could have been expected that the oxidation of II and III would produce tetrahydroquinazoline 1,3-dioxides V and VI, respectively [1]. It was found that the yields of 1,3-dioxides V and VI depend both on the solvent used [8] and on the oxidizing agent. When II was oxidized by active manganese dioxide in dioxane, 5,6,7,8-tetrahydro-

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