pyrrole with bp 60-61° (30 mm), d_4^{20} 0.9456, and n_D^{20} 1.5017. The results of analysis for C, H, and N were in agreement with the calculated values. The product was chromatographically identical to a genuine sample. According to the data in [4], this compound has bp 146-148° (749 mm), d_4^{20} 0.9438 and n_D^{20} 1.5025.

1-Isopropyl-2,4-dimethylpyrrole. A solution of 16.9 g (0.1 mole) of 4,5-dichloro-4-methyl-2-pentanone in 50 ml of ether was added dropwise at 20-25° to a solution of 18 ml (0.3 mole) of isopropylamine in 50 ml of ether, after which it was stirred at room temperature for 2 h. It was then refluxed for 3 h, cooled, washed with water, and extracted with ether. The organic layer was dried with magnesium sulfate, the solvents was removed by distillation, and the residue was vacuum fractionated in a stream of nitrogen to give 12 g (88%) of 1-isopropyl-2,4-dimethylpyrrole with bp 36-37° (2 mm), d_4^{20} 0.8886, and n_D^{20} 1.4788. Found: C 78.5; H 10.7; N 10.4%. $C_9H_{15}N$. Calculated: C 78.8; H 10.9; N 10.2%.

The other 1-alkylpyrroles were obtained in the same way (at 20-35°) (see Table 1).

1-Phenyl-2-methylpyrrole. A 15.5-g (0.1 mole) sample of 4.5-dichloro-2-pentanone was added dropwise at 30-35° to a mixture of 27 ml (0.3 mole) of aniline and 100 ml of water, after which the mixture was refluxed for 3 h and worked up as in the preceding experiments to give 11.6 g (74%) of 1-phenyl-2-methylpyrrole with bp 97-98° (9 mm), d_4^{20} 1.0341, and n_D^{20} 1.5790 [bp 112.5-113° (12 mm), d_4^{20} 1.0315, and n_D^{20} 1.5775]. The other 1-phenylpyrroles were obtained in the same way (Table 1).

LITERATURE CITED

1. I. I. Ibragimov, M. M. Guseinov, R. A. Gadzhily, V. G. Dzhafarov, and S. P. Godzhaev, Khim. Geterotsikl. Soedin., 1435 (1973).
2. P. Rosenmund and K. Grubel, Angew. Chem., 80, 702 (1968).
3. R. M. Rodebaugh and N. H. Cromwell, Tetrahedron Lett., 2859 (1967).
4. A. P. Terent'ev and M. A. Volodina, Dokl. Akad. Nauk SSSR, 88, 847 (1953).
5. F. Ya. Perveev and L. N. Gonoboblev, Zh. Org. Khim., 5, 1517 (1969).
6. Y. Chiang and E. Whipple, J. Am. Chem. Soc., 85, 1763 (1963).
7. F. Ya. Perveev and E. N. Kuznetsova, Zh. Obshch. Khim., 28, 2360 (1958).
8. É. I. Mamedov, Author's Abstract of Master's Degree, Baku (1974).

SYNTHESIS OF DERIVATIVES OF 2-BENZYLTETRAHYDROCARBAZOLE AND 4-BENZYLPYRAZINOTETRAHYDROCARBAZOLE

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2-Benzylidene- and 2-benzyltetrahydrocarbazoles were synthesized, and the latter were converted to 4-benzylpyrazinotetrahydrocarbazoles.

Up until now, only 3a.4,5,6-tetrahydropyrazino[3,2,1-jk]carbazoles with substituents only in the aromatic portion of the molecule were known [1]. For the first time we have obtained carbazoles of this sort with a benzyl substituent in the aliphatic ring for a comparison of their biological properties with those previously described. 1,2,3,4-Tetrahydro-1-oxo-2-benzylidenecarbazole derivatives (IIa-e), obtained by condensation of 1,2,3,4-tetrahydro-1-oxocarbazoles (Ia-e) with benzaldehyde in the presence of sodium methoxide or potassium hydroxide, were used as the starting compounds. Both of these catalysts ensure the synthesis of benxylidene derivatives IIa-e in high yields under mild conditions, as in the preparation of benzylidene derivatives of cyclohexanone and α-tetralone [2, 3].

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TABLE 1. Characteristics of 1,2,3,4-Tetrahydro-1-oxocarbazole Derivatives (II-III)

Compound	R^1	R^2	R^3	mp,* °C	Empirical formula	Found, %		Calc., %		IR spectrum, cm^{-1}			Yield, %
						C	H	C	H	$\nu_{C=O}$	ν_{NH}	$\nu_{C=O}$	
IIa	H	H	H	192—193	$C_{19}H_{15}NO$	83,0	5,5	83,4	5,5	1640	3260		80
IIb	CH_3	H	H	205—206	$C_{20}H_{17}NO$	83,6	5,9	83,6	5,9	1640	3290		80
IIc	H	H	CH_3	115—116	$C_{20}H_{17}NO$	83,7	5,9	83,6	5,9	1660			80
IId	CH_3O	H	H	185—186	$C_{20}H_{17}NO_2$	78,9	5,8	79,1	5,6	1645	3240		40
IIe	CH_3	CH_3	H	215—216	$C_{21}H_{19}NO$	83,7	6,2	83,6	6,3	1640	3300		80
IIIa	H	H	H	205—206	$C_{19}H_{17}NO$	83,0	6,3	82,9	6,2	1640	3260		80
IIIb	CH_3	H	H	190—191	$C_{20}H_{19}NO$	82,7	6,7	83,0	6,6	1650	3290		82
IIIc	H	H	CH_3	72—73	$C_{20}H_{19}NO$	83,0	6,6	83,0	6,6	1660			80
IIId	CH_3O	H	H	155—156	$C_{20}H_{20}NO_2$	78,3	6,5	78,4	6,6	1640	3240		60
IIIe	CH_3	CH_3	H	152—153	$C_{21}H_{21}NO$	83,0	6,6	83,1	6,9	1640	3300		40
IIIf	H	H	$C_6H_5COCH_2$	173—174	$C_{27}H_{23}NO_2$	82,0	5,9	82,4	5,8	1640		1680	60
IIIg	CH_3O	H	$C_6H_5COCH_2$	110—111	$C_{28}H_{25}NO_2$	79,3	6,1	79,4	5,9	1640		1690	50

* The compounds were purified for analysis by crystallization from dioxane–MeOH (2 : 1) (IIa,b,d,e and IIIa.b,d,e), methanol (IIc and IIIc), and acetone (IIIf,g).

TABLE 2. Characteristics of Pyrazinoindole Derivatives (IV)

Compound	R	R^1	mp,* °C	Empirical formula	Found, %			Calc., %			UV spectrum, λ_{max} (in alcohol), nm (log ε)	Yield, %
					C	H	N	C	H	N		
IVa	C_6H_5	H	140—141	$C_{27}H_{22}N_2$	86.6	6.0	7,4	86.5	5.9	7,4	240 (4,44) 295 (4,58) 350 (3,90) 418 (3,34) 440 (3,30)	70
IVb	H	CH_3	102—103	$C_{22}H_{20}N_2$	84.4	6.4	8,8	84.5	6.4	8,9	264 (4,75) 330 (3,64) 346 (3,58) 410 (3,49) 430 (3,43)	40
IVd	C_6H_5	CH_3O	125—126	$C_{28}H_{24}N_2O$	83.2	5.8	6.6	83.1	5.9	6.9	244 (4,36) 306 (4,60) 352 (3,83) 414 (3,13) 436 (3,09)	80

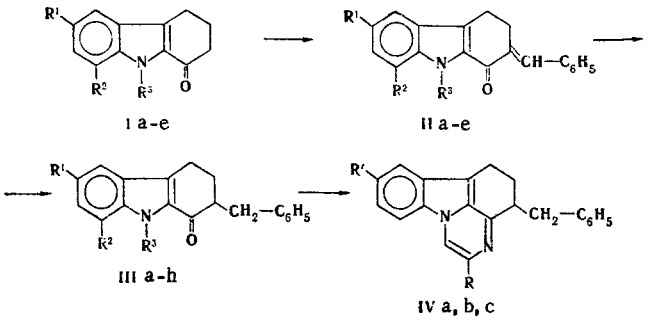
* The compounds were purified for analysis by crystallization from acetone (IVa.d) and ethyl acetate (IVb).

Whereas the carbonyl group of oxotetrahydrocarbazoles Ia-e shows up in the IR spectra as an intense absorption band at 1645-1700 cm^{-1}, the absorption band in the spectra of 2-benzylidene derivatives of oxotetrahydrocarbazole are found at ~1640-1660 cm^{-1}. The shift of the absorption bands to the low-frequency region confirms the fact that the C=O bond is conjugated with the C=C bond, i.e., substitution occurred at the α-methylene group with respect to the carbonyl group.

Hydrogenation of IIa-e at a pressure of 58 atm over a Raney nickel catalyst gave 1,2,3,4-tetrahydro-1-oxo-2-benzylcarbazole derivatives (IIIa-e), the IR spectra of which still contain an absorption band related to a carbonyl group: this constitutes evidence for selective hydrogenation of the double bond. A complex mixture of substances is formed if the hydrogenation is carried out at higher pressures.

The reaction of phenacyl bromide with the sodium derivatives of IIIa and IIId gives 1-oxo-2-benzyl-6-R^1-9-phenacyltetrahydrocarbazoles (IIIf.g), whereas alkylation of the sodium derivative of IIb with bromoacetaldehyde dibutylacetal gives 9-carbazolylacetaldehyde acetal (IIIh), which is a viscous liquid and is used for cyclization to pyrazinocarbazole derivatives without additional purification.

New absorption bands at 1680 and 1690 cm^{-1}, respectively, which characterize the phenacyl carbonyl group, appear in the IR spectra of phenacyl derivatives IIIf and IIIg. Compounds IIIf, IIIg, and IIIh were converted to 4-benzyl-3a,4.5.6-tetrahydro-8-R^1-pyrazino[3,2.1-jk]carbazole derivatives (IVa,b,d) by treatment with ammonium acetate in acetic acid.



I a-e II a-e

III a-h IV a, b, c

EXPERIMENTAL

The IR spectra of mineral oil suspensions of the compounds were recorded with Perkin–Elmer and UR-10 spectrometers.

1-Oxo-2-benzylidenetetrahydrocarbazoles (IIa-e). A mixture of 0.1 mole of the 1,2,3,4-tetrahydro-1-oxo-6-R^1-8-R^2-9-R^3 carbazole (Ia-e), 40 ml (0.35 mole) of benzaldehyde, and sodium methoxide, prepared from 0.1 g atom of sodium, was allowed to stand at room temperature for 3 h, after which the precipitated crystals were removed by filtration. Data on IIa-e are presented in Table 1.

1-Oxo-2-benzyltetrahydrocarbazoles (IIIa-e). A 0.085-mole sample of IIa-e was hydrogenated in the presence of 2 g of a Raney nickel catalyst in an autoclave at 80° and 50 atm for 6 h. The solution was filtered to remove the catalyst, and the filtrate was evaporated to dryness. Data on IIIa-e are presented in Table 1.

1-Oxo-2-benzyl-9-phenacyltetrahydrocarbazoles (IIIf-g). The synthesis was carried out by the methods described in [4, 5]. Data on IIIf-h are presented in Table 1.

3-Phenyl-4-benzyl-3a,4,5,6-tetrahydro-8-R^1-pyrazino[3,2,1-jk]carbazoles (IVa,d). These compounds were synthesized by the method in [5] and were isolated in the form of bases. Data on IVa,d are presented in Table 2.

4-Benzyl-3a,4,5,6-tetrahydro-8-methylpyrazino[3,2,1-jk]carbazole (IVb). An alcohol solution of sodium alkoxide, prepared from 1.61 g (0.07 g-atom) of sodium, was added to a suspension of 13.9 g (0.07 mole) of 1,2,3-tetrahydro-1-oxo-6-methylcarbazole in 40 ml of dry dimethylformamide (DMF), after which the alcohol formed in the reaction was removed by distillation, and 17.7 g (0.07 mole) of bromoacetaldehyde dibutylacetal in 70 ml of dry DMF was added to the residue. The mixture was then refluxed for 1.5 h, cooled, and poured into water. The liberated oil was extracted with benzene and dried by azeotropic removal of the water by distillation with benzene. The residue was dissolved in 300 ml of acetic acid. 50 g (0.19 mole) of ammonium acetate was added to the solution, and the mixture was refluxed for 3 h. It was then poured into water, and the aqueous mixture was neutralized with ammonium hydroxide and extracted with benzene. The extract was evaporated, and the residue was dissolved in chloroform and introduced into a column filled with silica gel. The impurities and IVb were eluted successively with chloroform. Data on IVb are presented in Table 2.

LITERATURE CITED

1. V. I. Shvedov, L. B. Altukhova, N. I. Andreeva, M. D. Mashkovskii. and A. N. Grinev, Khim. Farmats. Zh., No. 10, 14 (1972).
2. O. Wallach, Ber., 40, 70 (1907).
3. W. S. Rapson and R. G. Shuttleworth, J. Chem. Soc., 636 (1940).
4. V. I. Shvedov, L. B. Altukhova, and A. N. Grinev, Khim. Farmats. Zh., No. 3. 9 (1967).
5. V. I. Shvedov, L. B. Altukhova, and A. N. Grinev, Khim. Farmats. Zh., No. 3. 25 (1967).