EXPERIMENTAL

The UV spectra were recorded on a Specord instrument in ethanol. The IR spectra were obtained on an SP-1000 instrument for tablets with potassium bromide. The PMR spectra were obtained on an FX-900 instrument. The mass-spectral investigations were conducted on a JMS-DX 300 instrument at 70 eV. The reactions and the purities of the obtained compounds were monitored by TLC on Silufol UV-254 plates in benzene with development in iodine vapor. The elemental analyses for C and H correspond to the calculated compositions.

The initial p- and m-nitrophenyl-2-formylpyrroles were obtained by the method in [10].

General Procedure for the Production of Compounds (III, IV). In a 250-ml flask fitted with a Soxhlet extractor, in which there was 10 g of anhydrous sodium sulfate, we placed 0.5 g (23 mmoles) of 1-nitrophenyl-2-formylpyrrole and 23 mmoles of the respective amine, dissolved in 100-200 ml of dry benzene. The mixture was boiled for 20 h, the solvent was evaporated, and the solid residue was recrystallized from alcohol. The properties of the obtained compounds (III, IV) are given in Table 1.

LITERATURE CITED
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SYNTHESIS OF DERIVATIVES OF 1,3-DIHYDROSPIRO[2H-INDOLE-2,2'-PYRROLIDINE]

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Derivatives of 1,3-dihydrospiro[2H-indole-2,2'-pyrrolidine] were synthesized by the reaction of 2-methylene-2,3-dihydro-1H-indoles with α-iodoacetamide. Treatment of the products with alkyl iodides in the presence of potassium hydroxide gave 1'-substituted spiroindole-2,2'-pyrrolidines. The 1,3-dihydrospiro[2H-indole-2,2'-pyrrolidines] were converted by the action of perchloric acid into 2-(2-carbamoylethyl)-3H-indolium perchlorates.

The alklylation of heterocyclic enamines containing an exocyclic carbon-carbon double bond and derivatives of 2-methylene-2,3-dihydro-1H-indole, in particular, has so far been studied little [1, 2]. According to data in [3], the alklylation of 2-methylene-1,3,3-trimethyl-2,3-dihydro-1H-indole with methyl iodide takes place at the β-carbon atom of the enamine group, and the corresponding 2-isopropylidene base is formed. The reaction of the above-mentioned indoline enamine with 2-halogenoalkanols or oxiranes is also accompanied by initial C-alklylation and leads finally to derivatives of spiro[indole-2,2'-furan] [4, 5]. The spiroannellation of the pyrrole ring to the indole ring by the action of 2-methylene-2,3-dihydro-1H-indole with tetracyanoethylene was described earlier [6]. It is known that...
the alkylation of enamines of the pyrrolidine series, obtained from cycloalkanones, by α-
bromoacetamides takes place at the nitrogen atom of the enamine group with the formation of
1-carbamoylmethylpyrrolidines [7].

The aim of the present work was to investigate the products from the reaction of 2-
methylene-2,3-dihydro-1H-indoles (Ia, b) with α-iodoacetamide.

In the reaction of indoline enamines (Ia, b) with α-iodoacetamide in dioxane alkylation
takes place at the β-carbon atom of the enamino group, and the final reaction products are
derivatives of 1,3-dihydrospiro[2H-indole-2,2'-pyrrolidine] (IIa, b). In the course of the
reaction a certain part of the initial bases (Ia, b) is converted by the action of the re-
leased hydrogen iodide into 1,2,3,3-tetramethyl- and 2,3,3-trimethyl-1-ethyl-3H-indolium
iodides, respectively.

\[
\begin{align*}
&\text{CH}_3 & \text{CH}_2 & \text{CH}_2 & \text{CONH}_2 \\
&\text{N} & \text{R} & \text{R} & \text{H} \\
&\text{Ia,b} & \text{Ia,b} & \text{IIa,b} & \text{IIa,b}
\end{align*}
\]

The IR spectra of (IIa, b) contained absorption bands at 3170 (N-H) and 1695 cm\(^{-1}\) (C=O),
characteristic of five-membered lactams [8]. In the \(^{13}\)C NMR spectrum of (IIa) the signal
for the carbon atom of the carbonyl group appears at 170.4 ppm (γ-lactam) [9], while the
signal of the sp\(^3\)-hybridized α-carbon atom of the indole ring appears at 92.3 ppm.

The action of perchloric acid on the spiroindole-2,2'-pyrrolidines (IIa, b) leads to
opening of the pyrrolidine ring with the formation of 2-(2-carbamoyl methyl)-3H-indolium
chlororates (IIIa, b). 1'-Substituted 1,3-dihydrospiro[2H-indole-2,2'-pyrrolidines] (IVA, b)
were obtained by the reaction of (IIa) with methyl iodide and ethyl iodide in DMFA in the
presence of potassium hydroxide. Treatment of (IVA, b) with perchloric acid gave the 3H-
indolium perchlorates (Va, b).

\[
\begin{align*}
&\text{CH}_3 & \text{CH}_2 & \text{CH}_2 & \text{CONHR'} \\
&\text{N} & \text{R'} & \text{R'} & \text{H} \\
&\text{IVA,b} & \text{IVA,b} & \text{IVA,b} & \text{IVA,b}
\end{align*}
\]

The IR spectrum of the perchlorate (Va) contains absorption bands for the secondary
amide at 3395 (N-H), 1670 (C=O), and 1545 cm\(^{-1}\) (amide II) [8]. In the \(^{13}\)C NMR spectrum of
the perchlorate the signal of the sp\(^2\)-hybridized α-carbon atom of the indole ring lies at
198.0 ppm, which is typical of 3H-indolium salts [10, 11].

EXPERIMENTAL

The IR spectra were recorded on a Perkin-Elmer 325 instrument for tablets with potas-
sium bromide. The \(^{1}H\) NMR spectra were obtained on a Tesla BS-487C spectrometer at 80 MHz
with HMDS as internal standard. The \(^{13}\)C NMR spectra were obtained on a Tesla BS-567A spec-
trometer at 25.14 MHz. The mass spectra were recorded on an LKB-9000 instrument with direct
injection into the ion source at 160-180°C and 40 eV. The reaction and the individualities
of the compounds were monitored by TLC on aluminum oxide of III activity in the 3:5 acetone-
hexane system with development in iodine vapor. The elemental analyses agreed with the
calculated compositions.

5'-Oxo-1,3,3-trimethyl-1,3-dihydrospiro[2H-indole-2,2'-pyrrolidine] (IIa, C\(_4\)H\(_5\)N=O).
A mixture of 12.13 g (70 mmoles) of 2-methylene-1,3,3-trimethyl-2,3-dihydro-1H-indole (Ia)
and 18.5 g (100 mmoles) of α-iodoacetamide in 25 ml of dioxane was heated at 95-100°C for
5 h. The 1,2,3,3-tetramethyl-3H-indolium iodide (6.20 g) was filtered off, the filtrate
was evaporated, and the residue was crystallized twice from alcohol. The yield was 4.2 g
(26%); mp 205-206°C. \(^{1}H\) NMR spectrum (deuterochloroform): 1.17 (3H, s, 3-CH\(_3\)); 1.20 (3H,
s, 3-CH\(_3\)); 1.93-2.63 (4H, m, CH\(_2\)CH\(_2\)); 2.69 (3H, s, 1-CH\(_3\)); 6.22 (1H br.s NH); 6.33-7.26 ppm
(4H, m, ArH). \(^{13}\)C NMR spectrum (deuterochloroform): 28.2 (3-CH\(_3\)), 23.8 (C\(_{3r}\)), 24.7 (3-
CH\(_3\)), 28.2 (1-CH\(_3\)), 30.2 (C\(_{4r}\)), 46.1 (C\(_{3s}\)), 92.3 (C\(_{2s}\)), 107.5 (C\(_{7s}\)), 119.1, 121.7
(C\(_{7s}\), C\(_{a}\)), 128.0 (C\(_{a}\)), 136.6 (C\(_{3a}\)), 148.5 (C\(_{7a}\)), 176.4 ppm (C=O). M\(^+\) 230.