1,4 g Benzoylchlorid während 2 Std. unter Rückfluss erhitzt. Nach Abdestillieren des Lösungsmittels wird der Rückstand mit Eiswasser versetzt und mit Methylenchlorid ausgerührt. Die organische Phase wird nacheinander mit verd. Salzsäure, Wasser, Natriumcarbonatlösung und Wasser gewaschen. Erhalten werden 2,8 g eines schwach gelblichen Öls, $[\alpha]_D = -56{,}9°$ ($c = 1$, CH_3OH). DC.: Essigester. GC.: ST 200°, IT 220°, DT 280°, RT 1758 (99%ig rein). – IR.: 1741 (Ester-C=O), 1637 (Amid-C=O), 1601, 1577, 1518, 1494, 1229, 1193, 1261, 1128, 1028.

$C_{22}H_{25}NO_5$ (383,44) Ber. C 68,9 H 6,6 N 3,6% Gef. C 68,7 H 6,6 N 3,3%

Äquilibrierungsversuche. 10 g **5a** werden in 100 ml einer 1proz. Natriumäthylatlösung gelöst und das Ganze bei Rückflusstemperatur gehalten. Nach *ca.* 20 Min. stellt sich nach gas-chromatographischen Untersuchungen (siehe unter **5a**) ein Gleichgewicht **5a**:**5d** = 65:35 ein, das sich beim weiteren Erwärmen nicht mehr verändert. Nach 1 Std. wird das Lösungsmittel abdestilliert, der Rückstand mit Wasser versetzt und das Reaktionsprodukt in 250 ml Essigester aufgenommen. Die organische Phase wird nacheinander mit je 20 ml Wasser, gesättigter Natriumhydrogencarbonatlösung, Wasser, 1N Salzsäure und Wasser gewaschen. Der erhaltene ölige Rückstand wird in 10 ml Äther gelöst. Nach 1 Std. werden die ausgefallenen Kristalle abgesaugt, mit wenig Äther gewaschen und aus Benzol/*n*-Hexan umgelöst (3,0 g). Die Mutterlauge wird ein zweites Mal äquilibriert und, wie oben beschrieben, aufgearbeitet. Es werden insgesamt 3,2 g (1*S*,3*R*)-2-Acetyl-6,7-dimethoxy-1-methyl-1,2,3,4-tetrahydroisochinolin-3-carbonsäureäthylester (**5d**) in Form fast farbloser Kristalle vom Smp. 109–110° erhalten. DC.: Nitromethan (2mal laufen lassen). GC.: ST 190°, IT 260°, DT: 270°, RT 789 (100%). – IR: 1726 (Ester-C=O), 1627 (Amid-C=O), 1608, 1514, 1265, 1214, 1135, 1006. – MS.: u.a. Spitzen bei *m/e* 321 (M^+), 306 ($M^+ - 15$, CH_3), 278 ($M^+ - 43$, Acetyl), 264, 248, 206, 204, 190. – NMR.: wie **5c**. – $[\alpha]_D = +6{,}2°$ ($c = 1$, CH_3OH).

Bei der Äquilibrierung von **5d** unter denselben Bedingungen stellt sich dasselbe Gleichgewicht ein. Bei der Äquilibrierung von **5b** stellt sich das Gleichgewicht 65% **5c**, 35% **5b** ein. Das aus dem Äquilibrierungsgemisch isolierte **5c** verhält sich in allen Teilen wie bereits beschrieben. Die Äquilibrierung von **7a** und **8a** unter den obigen Bedingungen führt nach gaschromatographischen Untersuchungen zu einem Gemisch **7a**:**7d** bzw. **8a**:**8d** im Verhältnis von *ca.* 1:1. Diese Gemische wurden nicht aufgetrennt.

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92. On the Planarisation of Benzylideneaniline

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(27. I. 75)

Summary. The substituted benzylideneanilines **2–7** and the respective 3*H*-indoles **9–14** have been synthesized. A comparison of their electronic absorption spectra shows it is likely that 4-nitrobenzylidene-4'-dimethylaminoaniline (**6**) has a planar conformation.

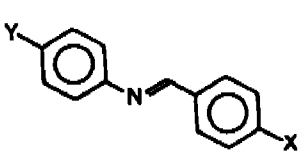
1. Introduction. – The X-ray structure analysis of benzylideneaniline (**1**) [1] has demonstrated that **1**, in contrast to its isoelectronic and essentially planar ana-

logues *trans*-azobenzene [2] and *trans* stilbene [3], is twisted by 55° about the C–N bond. Several years ago, the existence of such distortions was postulated [4–8] to explain the electronic spectrum of **1** which differs markedly from the spectra of azobenzene and stilbene. That the conformation of benzylideneaniline in solution is indeed very similar to that in the crystal was shown by a comparison of the electronic absorption spectrum with the reflection spectrum [9]. A simple model which takes into account the dependence of π-electron energy and non-bonded interactions on molecular conformations has consistently reproduced the twisted conformation of **1** and the almost planar conformations of azobenzene and stilbene [10]. The calculated π-electron energy plus the calculated non-bonded interactions favour the twisted benzylideneaniline over the planar conformation by *ca.* 8.4 kJ mol^{-1} (2 kcal mol^{-1}). For azobenzene and for stilbene the non-bonded interactions are relatively small and the potential curves are dominated by π-electron energy. However, strain due to non-bonded interactions and π-electron energy contribute roughly equal amounts to the potential of benzylideneaniline. Obviously the loss of π-electron energy in the twisted benzylideneaniline can be compensated partly by delocalisation of the nitrogen lone pair into the aniline ring [8]. If non-bonded interactions are neglected, π-electron energy is found to favour the planar conformation of **1** over the perpendicular conformation by only *ca.* 0.2 β_0 [9] [10].

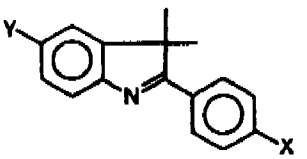
2. Problem. – With regard to this model, we thought it of interest to examine if by substitution in **1** by electron donating and/or electron attracting substituents the contribution of π-electron energy to the potential curve increases with increasing twist angle. Provided the non-bonded interaction energy does not increase to the same extent with decreasing twist angle, one would expect this angle to be reduced. Such a situation might eventually lead to a planar benzylideneaniline.

Substituent effects on the conformation of **1** have been discussed previously by several authors on the basis of electronic spectra [11] [12], the basicity of the nitrogen lone pair [13], and HMO-calculations [7]. Furthermore, the crystal structures of several substituted benzylideneanilines have been reported [1] [14]. These investigations appear to indicate the existence of a substituent effect, however, the results are by no means conclusive.

Therefore we decided to synthesize the benzylideneanilines **2–7** and to compare their electronic absorptions spectra with those of planar model compounds. The obvious planar models[1]) to choose were the 3*H*-indoles **9–14**.



1–7



8–14

1,	**8**	X = Y = H	
2,	**9**	X = NO_2, Y = H	
3,	**10**	X = H, Y = NO_2	
4,	**11**	X = NMe_2, Y = H	
5,	**12**	X = H, Y = NMe_2	
6,	**13**	X = NO_2, Y = NMe_2	
7,	**14**	X = NMe_2, Y = NO_2	

[1]) The suitability of 3*H*-indole **8** as a planar model for benzylideneaniline (**1**) has been discussed previously [8].

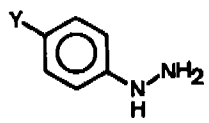
3. HMO-Model. – To test qualitatively the hypotheses that an increase in the π-electron energy contribution to the potential curves would occur we calculated, on the basis of the above HMO-model, the π-electron energy differences for twist angles of 0° and 90° for the benzylideneanilines **1–7**. The *Coloumb* and exchange integrals recommended by *Streitwieser* [15] were used. As seen from Table 1, the increase in the π-electron energy differences is quite small and therefore will not be discussed in detail. However, as expected from simple resonance considerations, the highest increase in stability is found for the planar conformation of 4-nitrobenzylidene-4'-dimethylaminoaniline (**6**). Therefore, if one neglects changes in non-bonded interactions[2]), we would expect **6** to be the most planar benzylideneaniline in the above series.

Table 1. *HMO-energy differences* $\Delta E = E_{\pi(\tau=0°)} - E_{\pi(\tau=90°)}$ *for benzylideneanilines* **1–7** *in* β_0*-units* ($\alpha_{\dot{N}} = 1.5$, $\alpha_{\dot{N}} = 0.5$, $\beta_{C-\dot{N}} = 0.8\,\beta_0$)

	ΔE_π	ΔE_π (XY) – ΔE_π (**1**)
1	0.207	–
2	0.243	0.036
3	0.222	0.015
4	0.207	0.000
5	0.221	0,014
6	0.284	0.077
7	0.240	0.033

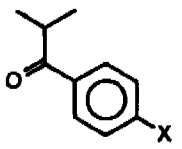
4. Syntheses. – *Benzylideneanilines.* The substituted benzylideneanilines **2–7** were prepared by known methods [16] from the respective anilines and benzaldehydes.

3H-Indoles[3]). 3*H*-Indoles can be synthesized by *Fischer*'s indole synthesis *via* the appropriate arylhydrazones [18]. The arylhydrazines **15** and the ketones **16** were known [19–21] or commercially available with the exception of isopropyl-*p*-nitrophenylketone (**16**, X = NO_2). This could be synthesized by *Grignard* reaction of benzaldehyde with $(CH_3)_2CHBr$, acetylation and nitration of the sec. alcohol, hydrolysis of the resulting ester and final oxidation to the ketone.



15

(Y = H, NO_2, NMe_2)



16

(X = H, NMe_2, NO_2)

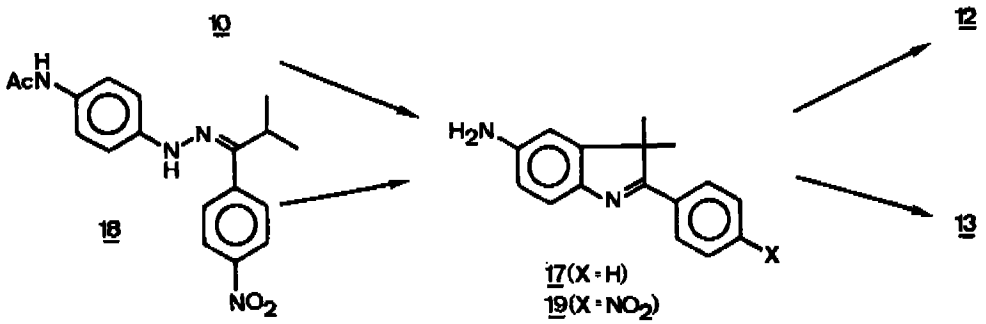
Indolisation of the respective arylhydrazones by the method described for 2-(*p*-dimethylaminophenyl)-3,3-dimethyl-3*H*-indole (**11**) [21] led to the 3*H*-indoles

[2]) However, X-ray analysis data demonstrate clearly the influence of *p*-substituents on the geometry of the C—N=C—C group [1].

[3]) A detailed discussion of the synthesis of the 3*H*-indoles **9–14** and the resulting problems may be found in [17].

9, **10** and **14**. This method, however, failed for the 3*H*-indoles **12** and **13** since *p*-dimethylaminophenylhydrazine is too unstable. 5-Dimethylamino-3,3-dimethyl-2-phenyl-3*H*-indole (**12**) could be obtained by reduction of the 3*H*-indole **10** to the 5-aminoderivative **17**, permethylation of **17** and a subsequent demethylation of the resulting ammonium salt of **17** with ethanolamine [22]. 5-Dimethylamino-3,3-dimethyl-2-(*p*-nitrophenyl)-3*H*-indole (**13**) was synthesized *via* the arylhydrazone **18** and the 3*H*-indole **19**. Permethylation of **19** and subsequent demethylation of the ammonium salt resulted in the formation of 3*H*-indole **13**.

Scheme



5. Results and Discussion. – *Electronic spectra in cyclohexane*[4]). In Fig. 2–7 and Tables 3–8 we have compared the electronic absorption behaviour of benzylideneanilines **2–7** and the 3*H*-indoles **9–14**. One can see immediately that the benzylideneanilines fall into two groups. In one group the mononitro derivatives exhibit spectra

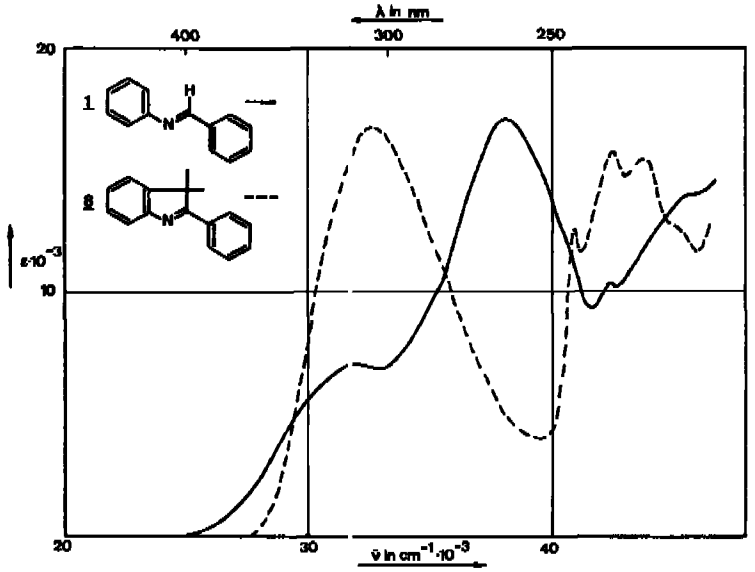


Fig. 1. *Electronic spectra of* **1** *and* **8** *in cyclohexane*

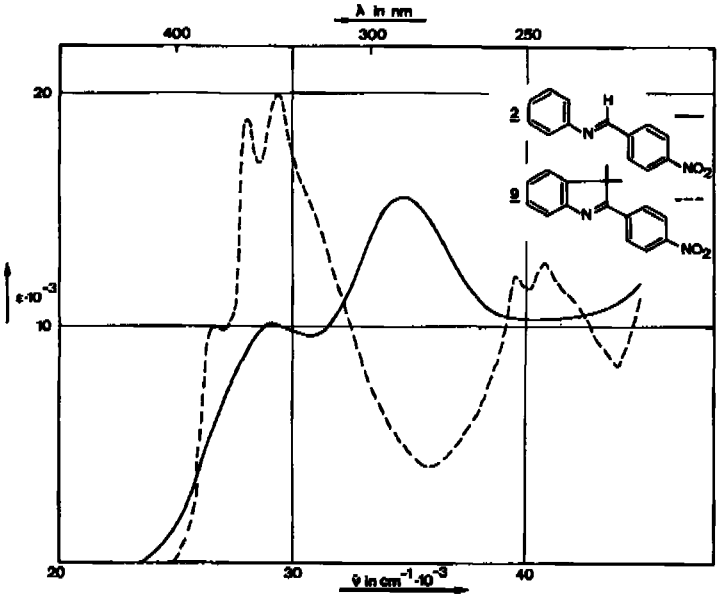


Fig. 2. *Electronic spectra of* **2** *and* **9** *in cyclohexane*

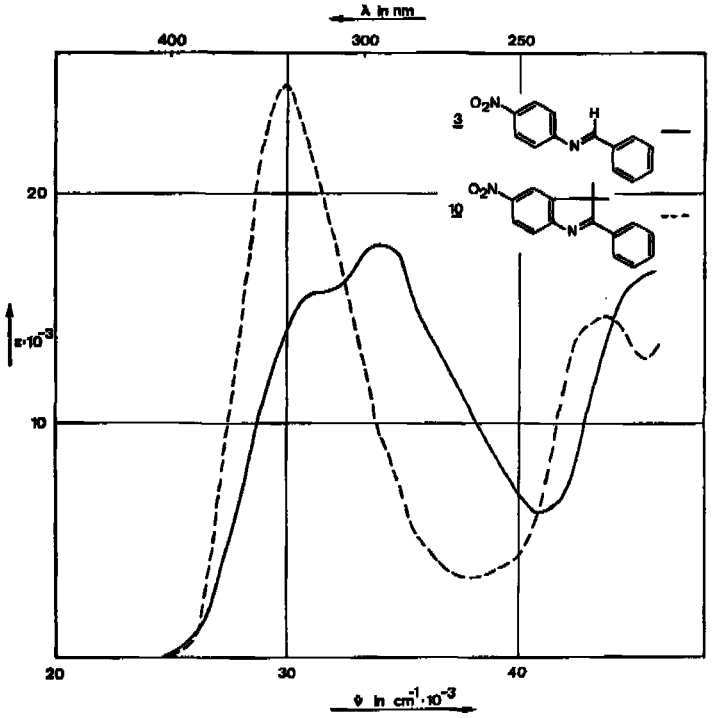


Fig. 3. *Electronic spectra of* **3** *and* **10** *in cyclohexane*

Table 2. *Absorption maxima of* **1** *and* **8** *in cyclohexane*

	1			**8**			
$\tilde{\nu}$	32000	38200	42400	32300	40800	42600	43900
λ	313	262	236	309	245	235	228
ε	6860	17100	10300	16600	12500	15800	15300

Table 3. *Absorption maxima of* **2** *and* **9** *in cyclohexane*

	2		**9**				
$\tilde{\nu}$	28900	34700	26600	28000	29400	39500	40800
λ	346	288	376	357	340	253	245
ε	10200	15600	9900	18900	19900	12200	12700

Table 4. *Absorption maxima of* **3** *and* **10** *in cyclohexane*

	3			**10**		
$\tilde{\nu}$	(30800)	33900	5500	29800	(42700)	43700
λ	(325)	295	220	335	(234)	229
ε	(15400)	17700	6500	24600	(14200)	14600

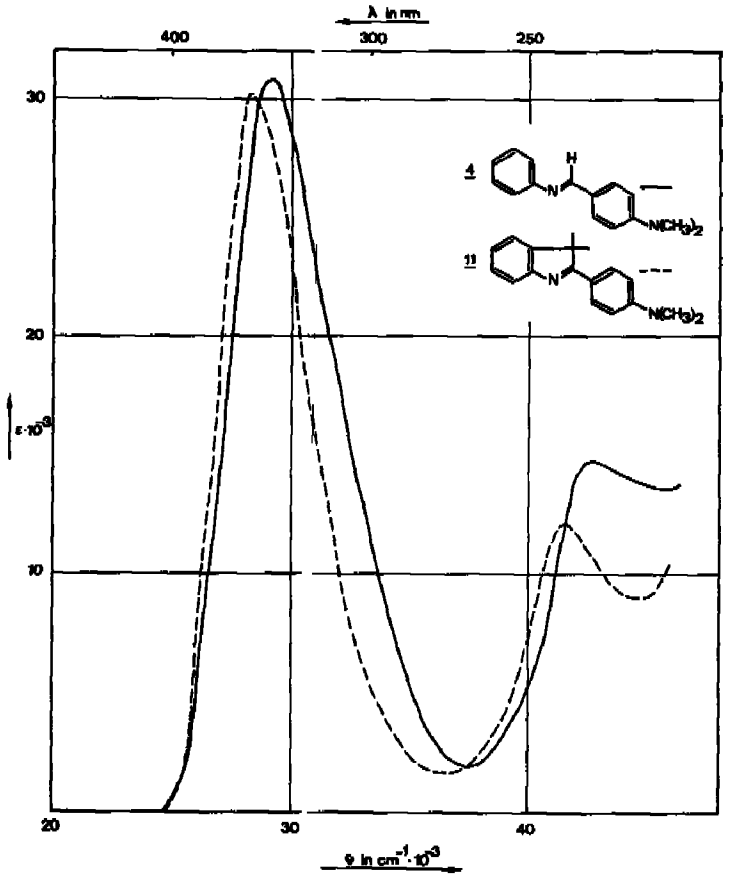


Fig. 4. *Electronic spectra of* **4** *and* **11** *in cyclohexane*

similar to that of benzylideneaniline itself (Fig. 1 and Table 2); the spectra differ markedly from the spectra of the respective 3*H*-indoles **9** and **10**. In the other group the dimethylamino derivatives **4** and **5** and the disubstituted benzylideneanilines **6** and **7** have spectra which are very similar or virtually identical to those of the respective 3*H*-indoles.

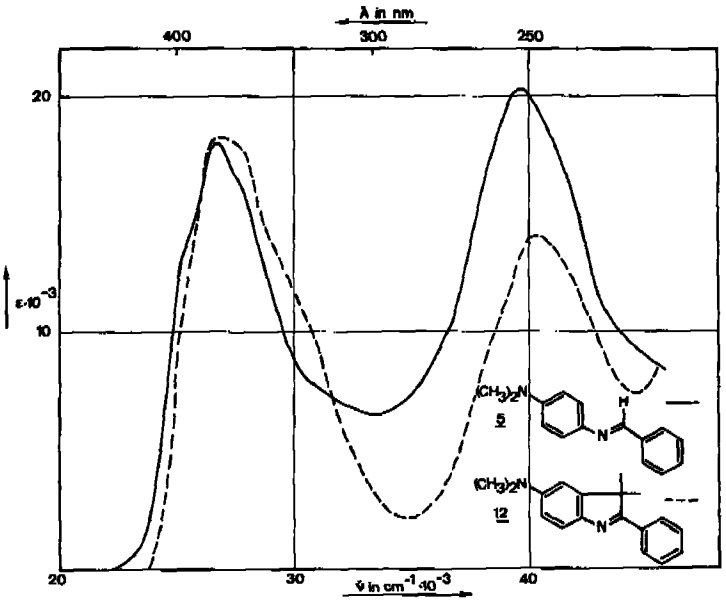


Fig. 5. *Electronic spectra of* **5** *and* **12** *in cyclohexane*

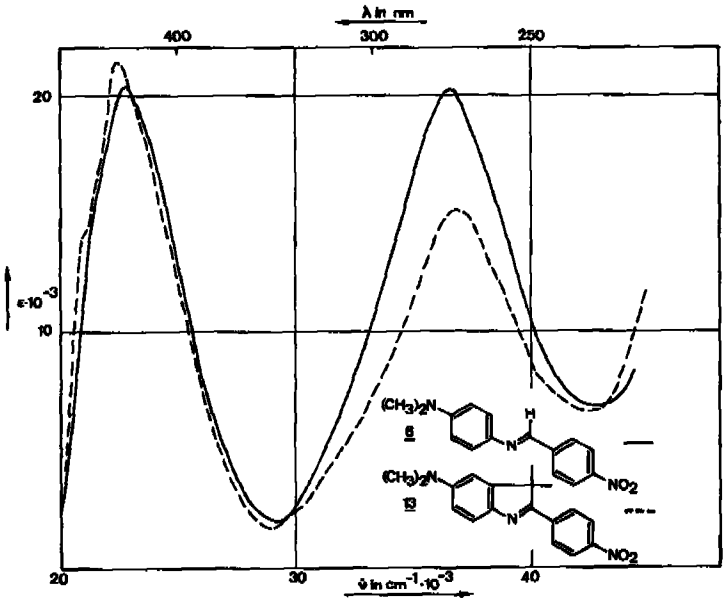


Fig. 6. *Electronic spectra of* **6** *and* **13** *in cyclohexane*

Table 5. *Absorption maxima of* **4** *and* **11** *in cyclohexane*

	4		**11**	
$\tilde{\nu}$	29200	42700	28600	41700
λ	342	234	350	240
ε	30800	14800	30100	12100

Table 6. *Absorption maxima of* **5** *and* **12** *in cyclohexane*

	5		**12**	
$\tilde{\nu}$	26700	39700	26900	40300
λ	374	252	372	248
ε	18000	20200	18200	14000

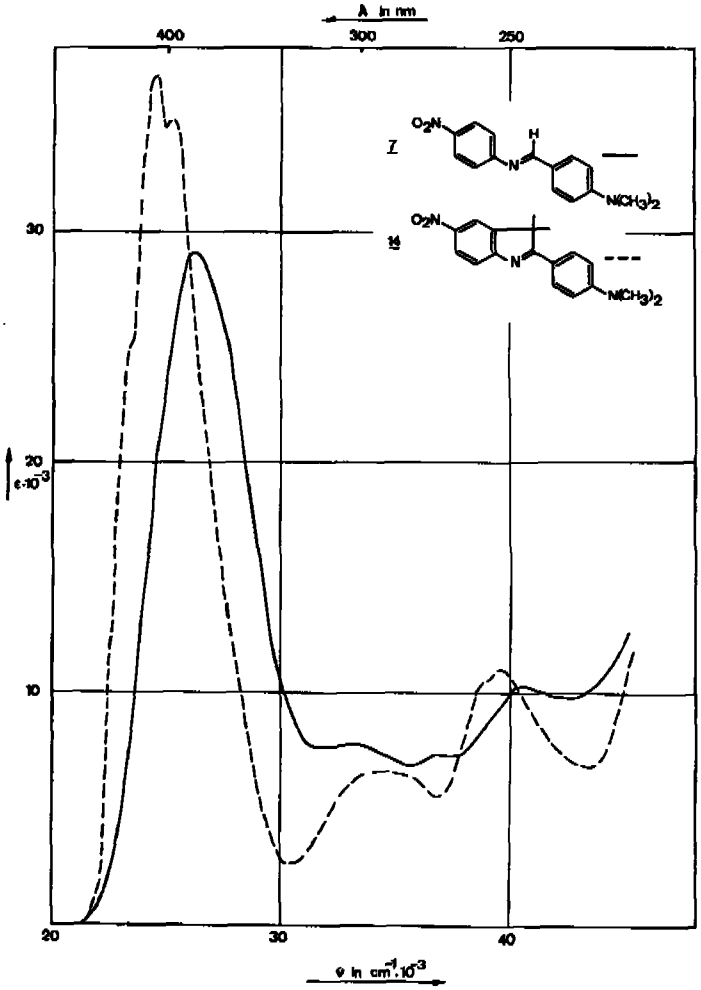


Fig. 7. *Electronic spectra of* **7** *and* **14** *in cyclohexane*

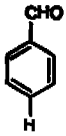
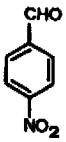
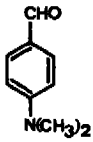
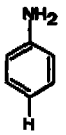
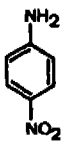
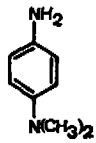
Table 7. *Absorption maxima of* **6** *and* **13** *in cyclohexane*

	6		**13**	
$\tilde{\nu}$	22800	36500	22400	36700
λ	438	274	447	272
ε	20300	20200	21200	15200

Table 8. *Absorption maxima of* **7** *and* **14** *in cyclohexane*

	7			**14**			
$\tilde{\nu}$	26200	33300	40700	24500	25100	34000	39500
λ	382	300	246	409	398	294	253
ε	29100	7660	10400	36800	34800	6560	10900

Table 9. *Absorption maxima of substituted benzaldehydes and anilines in cyclohexane*

	**20**	$\tilde{\nu}$	(34500)	35700	(40200)	41300
		λ	(290)	280	(249)	242
		ε	(1300)	1480	(11400)	14000
	**21**	$\tilde{\nu}$	(32600)	(33900)	38600	
		λ	(307)	(295)	259	
		ε	(1470)	(2220)	15400	
	**22**	$\tilde{\nu}$	30600	31200	(41700)	42700
		λ	327	320	(240)	234
		ε	39300	37100	(10700)	11700
	**23**	$\tilde{\nu}$	35100	42700		
		λ	285	234		
		ε	1520	6910		
	**24**	$\tilde{\nu}$	31100	(43300)	44200	
		λ	322	(231)	226	
		ε	15400	(6900)	7030	
	**25**	$\tilde{\nu}$	31000	38900		
		λ	323	257		
		ε	2500	12800		

The various interpretations of the electronic spectrum of benzylideneaniline have been discussed in [8]. The present, generally accepted view is based on the assumption that – depending on the twist angle – transitions in chromophore C are accompanied by additional transitions in chromophores C_a and C_b (Fig. 8) [4] [11].

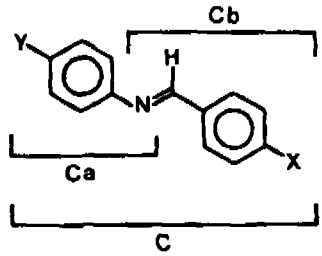
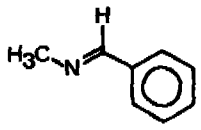


Fig. 8. *Chromophores in non-planar benzylideneanilines*

Since benzylidenemethylamine (**26**) and benzaldehyde (**20**) have very similar electronic spectra [6] [11], we have collected the absorption maxima of benzaldehydes **20–22** for chromophore C_b and of anilines **23–25** for chromophore C_a in Table 9.



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4-Nitrobenzylideneaniline (2) and benzylidene-4′-nitroaniline (3). – Comparison of the electronic spectra of **2** and **3** with the absorption maxima of the respective benzaldehydes **21** and **20** and the anilines **23** and **24** suggests that both spectra can be interpreted in terms of the superpositions of transitions in chromophores C, C_a and C_b. The character of the spectra (low intensity of the band at lowest wave number and high intensity of the second band) indicates torsion angles for **2** and **3** which lie in the range of the torsion angle of benzylideneaniline itself.

4-Dimethylaminobenzylideneaniline (4) and benzylidene-4′-dimethylaminoaniline (5). – The similarity of the spectra of **4** and 3*H*-indole **11** would indicate a more or less planar conformation of **4**. However, since the spectrum of 4-dimethylaminobenzaldehyde (**22**) (Table 9) is similar, the spectrum of **4** could also consist of a superposition of transitions in chromophores C, C_a and C_b. Therefore no conclusion can be drawn regarding the conformation of **4**. In contrast to this the spectra of **5** and the 3*H*-indole **12** exhibit very similar absorption bands at 26700 and 26900 cm^{-1} which have bathochromic shifts of *ca.* 4200 and 8200 cm^{-1} from the long wavelength absorptions of the aniline **25** and benzaldehyde. Therefore the absorption of **5** at 26700 cm^{-1} is obviously a transition in chromophore C indicating a planar conformation. However, the higher intensity of the second band at 39700 cm^{-1} of **5** and in the region of the minimum at *ca.* 34000 cm^{-1} might come from additional transitions in chromophores C_a and C_b (see Table 9). From this we conclude that benzylidene-4′-dimethylaminoaniline (**5**) has only a small torsion angle.

4-Nitrobenzylidene-4'-dimethylaminoaniline (6) and 4-dimethylaminobenzylidene-4'-nitroaniline (7). – The spectra of 4-nitrobenzylidene-4'-dimethylaminoaniline (**6**) and the respective 3*H*-indole **13** (Fig. 6) show – apart from those in Fig. 4 – the closest similarity of the whole series. We can conclude that **6** is a planar or nearly planar benzylideneaniline. A comparison with the absorption maxima of the aldehyde **21** and the aniline **25** indicates that the higher extinction coefficient of the second band at 36500 cm^{-1} might be due to transitions of low intensity in chromophores C_a and C_b.

For the alternative substitution pattern in benzylideneaniline **7** we find that the character of the electronic spectrum is the same as that of the 3*H*-indole **14**. However, the main absorption band shows a hypsochromic shift of *ca.* 1700 cm^{-1}. A comparison with the absorption maxima of the aldehyde **22** and aniline **24** again suggests a superposition of transitions in chromophores C, C_a and C_b. Therefore **7** is obviously not planar, but the twist angle seems to be reduced to some extent.

Electronic spectra in conc. sulfuric acid. Protonation of benzylideneaniline (**1**) on the nitrogen lone pair leads to planarisation. This was shown by comparison of the spectra of **1** and **8** in conc. sulfuric acid [8]. In accordance with this observation we have also found planarisation of the substituted benzylideneanilines **2–7** [17]. The respective data are summarized in Table 10.

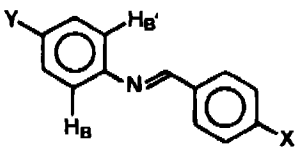
^1H- *NMR. Spectra.* Recently, ^{1}H- NMR. spectroscopic investigations of the conformation of several benzylideneanilines have been published [23]. We have investigated the chemical shifts of the *ortho*-protons of the aniline ring in **2–7** and of the respective proton in the 3*H*-indoles **9–14** as well as the chemical shifts of the azomethine protons. The results are in agreement with the conclusions which we have drawn from the electronic absorption spectra. As indicated in Table 11 for the aromatic protons, however, the observed chemical shift differences are too small to be discussed here in detail [17].

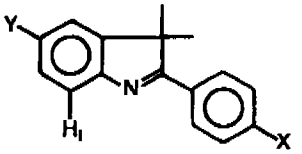
Table 10. *Absorption maxima of benzylidenanilinees* **2–7** *and 3H-indoles* **9–14** *in conc.* H_2SO_4

	ν (λ, ε)			
2	27400 (365, 19800)	36500 (274, 10300)		
9	27000 (370, 14000)	37100 (270, 10700)		
3	28600 (350, 31600)	[46500 (215, 12300)]		
10	27800 (359, 26800)	45000 (222, 12000)		
4	29800 (345, 18300)	38200 (262, 9720)		
11	28500 (352, 12400)	[33300 (300, 4950)]	39400 (254, 9000)	40200 (249, 7960)
5	30000 (333, 26000)			
12	29200 (343, 20000)	[39800 (251, 3620)]	41200 (243, 4160)	
6	29700 (336, 24600)	[37000 (270, 6500)]		
13	28900 (346, 17800)	36200 (276, 9070)		
7	30000 (333, 29100)	[38500 (260, 4610)]		
14	28900 (346, 21500)	[36800 (272, 5290)]		

Conclusions. – Summarizing our results we can conclude that 4-nitrobenzylidene-4'-dimethylaminoaniline (**6**) has a planar or nearly planar conformation. In benzylidene-4'-dimethylaminoaniline (**5**) the twist angle is reduced to quite an extent. This is to be expected if it is assumed that delocalisation of the nitrogen lone pair

Table 11. *Chemical shifts of protons H_B, $H_{B'}$ in benzylideneanilines* **2–7** *and of proton H_I in 3H-indoles* **9–14** *in $CDCl_3$* (ppm, $\delta_{TMS} = 0$)





B		I		$\delta_{H_I} - \delta_{H_B}$
1	7.21–7.31 [a])	**8**	7.70	0.39–0.49
2	7.25–7.37 [a])	**9**	7.75	0.38–0.50
3	7.19	**10**	7.73	0.54
4	7.15–7.25 [a])	**11**	7.63	0.38–0.48
5	7.24	**12**	7.57	0.33
6	7.30	**13**	7.60	0.30
7	7.17	**14**	7.63	0.46

[a]) Complex multiplets for the aniline protons.

into the aniline ring partly compensates the loss of π-electron energy in the twisted benzylideneaniline: the dimethylamino group in the *aniline* ring has the major effect since the delocalisation of the nitrogen lone pair is impeded. When the nitro group is also present as substituent, obviously an additional increase in the slope of π-electron energy with increasing twist angle occurs and the minimum of the potential curve is further shifted to a smaller twist angle. As seen from the electronic spectra of 4-nitrobenzylideneaniline (**2**) and benzylidene-4'-nitroaniline (**3**) substitution by the nitro group alone has only a minor effect. However, when the dimethylamino group is also present (**7**), partial planarisation is observed.

A comparison of electronic absorption spectra with reflection spectra and X-ray structure analysis data of the above benzylideneanilines should provide further information.

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Experimental Part

General. – Melting points are uncorrected. IR. spectra were run on a *Beckman* IR-33 (intensities: *s* = strong, *m* = medium, *w* = weak), ^{1}H-NMR. spectra at 60 MHz (*Varian* A-60, T-60) in $CDCl_3$; chemical shifts are given in ppm (δ, TMS = 0), coupling constants in Hz; *s* = singlet, *d* = doublet, *sext* = sextet, *oct* = octet, *m* = multiplet. Mass spectra were run on a *Hitachi Perkin Elmer* RMU-6 (Organ.-chem. Laboratorium ETHZ) and electronic spectra on *Beckman* Acta II and Acta III. Silica gel plates were used for thin and thick layer chromatography (F 254, PF 254), and for column chromatography silica gel (0.05–0.2 mm) from *Merck AG*, Darmstadt, was used.

3,3-Dimethyl-2-(*p*-nitrophenyl)-3*H*-indole (9). – *2-Methyl-1-phenylpropanol.* 171.6 g (1.39 mol) isopropyl bromide in 200 ml abs. ether were added dropwise with stirring to 33.2 g (1.37 mol) Mg filings in 200 ml abs. ether at such a rate that the solution was kept boiling. The mixture was refluxed for 30 min. A solution of freshly distilled benzaldehyde (120 g, 1.13 mol) in abs. ether (100 ml) was added and the mixture refluxed for an additional 60 min. The solution

was allowed to cool and poured onto ice (140 g). The resulting precipitate was dissolved with HCl (19%) and the aqueous layer separated and extracted with ether. The combined ether extracts were washed with a saturated solution of $NaHSO_3$, 2M $NaHCO_3$, and water, and dried over Na_2SO_4. After removal of the solvent the crude product (138 g) was distilled to give 129.7 g (77%) of the alcohol. B.p. 110–113°/17 Torr (112–113°/15 Torr [24]); $n_D^{18.7} = 1.5186$ (1.5193 [24]).

2-Methyl-1-phenylpropyl acetate. 45.0 g (0.300 mol) 2-methyl-1-phenylpropanol, 30.6 g (0.300 mol) acetic anhydride and 28.4 g (0.360 mol) pyridine were refluxed for 3 h. The reaction mixture was allowed to cool, poured into ice water (100 ml) and the aqueous layer was extracted with ether. The combined organic layers were washed with 2M HCl and H_2O, dried and distilled to give 46.0 g (80%) ester. B.p. 104–109°/8 Torr (122–125°/20 Torr [24]); $n_D^{20} = 1.4930$. – ^{1}H-NMR.: 0.79 (3H, *d*, $J = 7$); 0.96 (3H, *d*, $J = 7$); 2.06 (3H, *s*); 2.10 (1H, *oct*, $J = 7$); 5.48 (1H, *d*, $J = 7$); 7.30 (5H, *s*).

2-Methyl-1-(p-nitrophenyl)propanol. 50 ml fuming HNO_3 were added slowly with stirring at –50° to 42.30 g (0.22 mol) 2-methyl-1-phenylpropyl acetate in 100 g acetic anhydride. The mixture was stirred for 12 h at –40°, poured into ice water (300 ml) and extracted with ether. The ether extracts were neutralized with 2M $KHCO_3$, washed with H_2O, dried over Na_2SO_4 and distilled (125°C/0.6 Torr) to give 37.9 g of a mixture of the *o*- and *p*-isomer.

28.4 g of this mixture were hydrolized at room temperature with 330 ml of methanolic 1M KOH. Hydrolysis is complete immediately after addition of KOH. The mixture was neutralized with dry ice, filtered from the precipitated K_2CO_3 and evaporated to dryness. The residue was taken up into water and extracted with ether. The ether layer was washed with 1M HCl and water and dried over Na_2SO_4. Evaporation of the ether gave 15.9 g crude product. The separation and purification of the *p*-isomer was achieved by chromatography in two batches on a column [1 m × 4 cm, 450 g silica gel, eluent: ethyl acetate/petroleum ether (80–110) 15:85]. 5.96 g (19%) of the *p*-isomer were obtained. – ^{1}H-NMR.: 0.89 (3 H, *d*, $J = 7$); 0.96 (3 H, *d*, $J = 7$); 2.02 (1H, *oct*, $J = 7$); 2.29 (1H, *s*); 4.62 (1H, *d*, $J = 7$); 7.60 (2 H, *d*, $J = 9$); 8.31 (2 H, *d*, $J = 9$).

Isopropyl-p-nitrophenylketone. 2.88 g (14.8 mmol) 2-methyl-1-(*p*-nitrophenyl)propanol in 30 ml AcOH were mixed at room temp. with a solution of 2.07 g (20.7 mmol) CrO_3 in 15 ml H_2O and 52 ml AcOH. After addition, the mixture was stirred for 1 h, diluted with 50 ml H_2O and extracted with ether. The extracts were washed with 2M $KHCO_3$, saturated $NaHSO_3$ solution, H_2O and dried over Na_2SO_4. Evaporation of the ether gave 2.28 g (80%) ketone which cristallized on standing. M.p. 51°. – ^{1}H-NMR.: 1.25 (6 H, *d*, $J = 7$); 3.57 (1H, *sext*, $J = 7$); 8.08 (2 H, *d*, $J = 9$); 8.28 (2 H, *d*, $J = 9$).

3H-Indole **9.** 2.28 g (11.8 mmol) isopropyl *p*-nitrophenyl ketone and 1.28 g (11.8 mmol) phenylhydrazine were heated to 110° for 2 h. On addition of 10 ml C_2H_5OH the hydrazone cristallized in orange needles. It was refluxed with 15 ml C_2H_5OH and 15 ml ethanolic HCl for 1 h. After cooling, the precipitate was washed with H_2O and neutralized with cold 2M NaOH. Extraction with ether gave 0.862 g of a yellow powder which was recrystallized from C_2H_5OH (0.809 g, 26%). M.p. 143–144°.

$C_{16}H_{14}N_2O_2$ (266.3) Calc. C 72.16 H 5.30 N 10.52% Found C 72.18 H 5.33 N 10.52%

IR. (KBr): 3000 *w*, 2950 *w*, 2880 *w*, 1600 *m*, 1530 *s*, 1500 *m*, 1475 *m*, 1455 *m*, 1350 *s*, 1320 *m*, 1300 *m*, 1110 *m*, 990 *m*, 860 *s*, 850 *s*, 750 *s*, 700 *s*. – ^{1}H-NMR.: 1.55 (6 H, *s*); ~7.5 (3 H, *m*); ~7.7 (1H, *m*); 8.22 (4 H, *s*). – MS. (80°): 266 (M^+, 100), 251 (25), 220 (20), 205 (25), 144 (18), 117 (39), 103 (32), 91 (20), 77 (30).

3,3-Dimethyl-5-nitro-2-phenyl-3*H*-indole (10). – 5.92 g (40.0 mmol) isopropyl phenyl ketone [20] and 6.12 g (40.0 mmol) *p*-nitrophenylhydrazine were heated to 110° for 3 h. Addition of 15 ml C_2H_5OH and cooling resulted in precipitation of 9.40 g of a yellow product which was refluxed for 1 h with 25 ml C_2H_5OH and 15 ml ethanolic HCl. After cooling, the solution was filtered from the precipitated NH_4Cl and evaporated to dryness. The residue was taken up into ice water which was made alkaline with 2 M NaOH and then extracted with ether. After drying over K_2CO_3 and evaporation the residue was crystallized by addition of 5 ml C_2H_5OH and recrystallized twice from C_2H_5OH (1.17 g, 11%). M.p. 147–149°.

$C_{16}H_{14}N_2O_2$ (266.3) Calc. C 72,16 H 5.30 N 10.52% Found C 72.69 H 5.30 N 10.71%

IR. ($CHCl_3$): 2980 *m*, 2940 *m*, 2880 *m*, 1625 *m*, 1605 *m*, 1515 *m*, 1500 *m*, 1460 *m*, 1345 *s*, 1320 *m*, 1310 *m*, 1125 *m*, 910 *m*, 850 *w*. – ^{1}H-NMR.: 1.60 (6 H, *s*); ~7.5 (3 H, *m*); 7.73 (1 H, *d*, $J = 9$); ~8.2 (4 H, *m*). – MS. (60°): 266 (M^+, 100), 251 (32), 220 (21), 205 (24), 115 (30), 91 (17).

5-Dimethylamino-3,3-dimethyl-2-phenyl-3*H*-indole (12). – *5-Amino-3,3-dimethyl-2-phenyl-3*H*-indole* (**17**). To a suspension of 1.77 g (6.65 mmol) **10** in 9 ml 95% C_2H_5OH a solution of 2.96 g (40.0 mmol) $NaHS \cdot H_2O$ in 9 ml H_2O was added and the mixture heated to 110° for 30 min. After evaporation of the solvent, the residue was taken up into H_2O. Extraction with $CHCl_3$ and evaporation of the dry extract gave an oily, dark yellow residue which solidified on dissolution in petroleum ether (80–110) (10 ml) and cooling (1.13 g, 72%). M.p. 110° (from petroleum ether).

^{1}H-NMR.: 1.54 (6 H, *s*); 3.76 (2 H, *s*); 6.6 6.8 (2 H, *m*); 7.4–7.7 (4 H, *m*); 8.2 (2 H, *m*). MS. (80°): 236 (M^+, 100), 221 (48).

*3*H*-Indole* **12**. 1.12 g (4.75 mmol) of **17** were suspended together with 1.2 g $NaHCO_3$ in 11 ml H_2O and over a period of 90 min 2.70 g (21.60 mmol) $(CH_3O)_2SO_2$ were added dropwise. After 5 h reaction time addition of 2.0 g (13.0 mmol) NaI in 14 ml H_2O resulted in precipitation of 1.37 g of a yellow salt which was treated for 90 min at 100° with $H_2N(CH_2)_2OH$. After cooling the mixture was diluted with H_2O and extracted with petroleum ether (80–100). The organic layer was dried over Na_2SO_4 and concentrated to 5 ml. On cooling the solution the 3*H*-indole **12** crystallized in orange needles (0.281 g, 22%). M.p. 117°.

$C_{18}H_{20}N_2$ (264.4) Calc. C 81.78 H 7.63 N 10.60% Found C 81.77 H 7.67 N 10.59%

IR. ($CHCl_3$): 2970 *m*, 2940 *m*, 2870 *m*, 2820 *w*, 1620 *s*, 1605 *m*, 1595 *m*, 1500 *s*, 1470 *m*, 1440 *m*, 1365 *s*. – ^{1}H-NMR.: 1.53 (6 H, *s*); 2.95 (6 H, *s*); ~6.7 (2 H, *m*); ~7.4 (3 H, *m*); 7.57 (1 H, *d*); ~8.1 (2 H, *m*). – MS. (200°): 264 (M^+, 100), 249 (30).

5-Dimethylamino-3,3-dimethyl-2-(*p*-nitrophenyl)-3*H*-indole (13). – 0.805 g (4.17 mmol) isopropyl *p*-nitrophenyl ketone in 65 ml 95% C_2H_5OH were mixed with a solution of 1.013 g (5.03 mmol) *p*-acetylaminophenylhydrazine hydrochloride [25] in 15 ml H_2O and 18 ml 0.5M NaOAc. The mixture was heated to 60° and N_2 was bubbled slowly through. After 20 h 1.17 g of a red powder were filtered off and refluxed with 20 ml C_2H_5OH and 25 ml ethanolic HCl for 45 min. The mixture was cooled, filtered from NH_4Cl and evaporated. The residue was taken up into ice water, made alkaline with 2M NaOH and extracted with ether. The ether layers were dried over K_2CO_3 and evaporated to dryness. The resulting crude product of **19** (0.800 g) was suspended in a solution of 0.72 g $NaHCO_3$ in 10 ml H_2O. Over a period of 1 h 1.40 g (11 mmol) $(CH_3O)_2SO_2$ were added dropwise with stirring. The mixture was then stirred for an additional 4 h at room temperature and 1 h at 80°. 2.0 g (13 mmol) NaI in 9 ml H_2O were added and the mixture cooled. The resulting precipitate was separated and heated to 100° for 1 h with 5 ml $H_2N(CH_2)_2OH$. After cooling, 50 ml H_2O were added and the mixture extracted with $CHCl_3$. The organic layer was dried over K_2CO_3 and evaporated. The residue (0.643 g) was chromatographed on silica gel plates (petroleum ether (80–110)/ethyl acetate 1:3). The main orange band was eluted with $CHCl_3$ and again chromatographed (petroleum ether (80–110)/ethyl acetate 85:15). This gave 0.218 g of a dark red product which was recrystallized twice from C_2H_5OH. The red-violet crystals (0.147 g) were rechromatographed on silica gel plates ($CHCl_3$) and recrystallized (C_2H_5OH) to give 0.102 g (8%) pure 3*H*-indole **13**. M.p. 217°.

$C_{18}H_{19}N_3O_2$ (309.4) Calc. C 69.88 H 6.19 N 13.58% Found C 69.61 H 6.15 N 13.37%

IR. ($CHCl_3$): 2940 *m*, 2915 *m*, 2855 *m*, 2805 *w*, 1605 *m*, 1585 *s*, 1490 *m*, 1460 *m*, 1430 *m*, 1340 *s*, 1130 *m*, 1110 *m*, 1075 *m*, 1015 *m*, 855 *m*. – ^{1}H-NMR.: 1.53 (6 H, *s*); 3.00 (6 H, *s*); ~6.7 (2 H, *m*); 7.60 (1 H, *d*, $J = 9$); 8.28 (4 H, *s*). – MS. (100°): 309 (M^+, 100), 294 (29), 279 (18), 263 (15), 248 (15).

2-(*p*-Dimethylaminophenyl)-3,3-dimethyl-5-nitro-3*H*-indole (14). – 1.014 g (5.31 mmol) *p*-dimethylaminophenyl isopropyl ketone [21] and 0.822 g (5.37 mmol) *p*-nitrophenylhydrazine were heated at 110° for 3 h. Then 10 ml C_2H_5OH and 20 ml ethanolic HCl were added to the mixture and the whole refluxed for 1 h. After cooling, the precipitated NH_4Cl was filtered off and the filtrate evaporated to dryness. The residue was taken up into ice water and 2M NaOH, and extracted with ether. The organic layers were dried over K_2CO_3 and evaporated. Addition of 3 ml C_2H_5OH to the oily residue (1.47 g) resulted in formation of an orange red pre-

cipitate (0.58 g) which was chromatographed in two batches on a column (40 × 1.5 cm, 40 g silica gel, $CHCl_3$). A red product was collected (0.292 g) and recrystallized from CH_3OH (0.174 g, 11%). M.p. 195°.

$C_{18}H_{19}N_3O_2$ (309.4) Calc. C 69.88 H 6.19 N 13.58% Found C 69.74 H 6.16 N 13.35%

IR. (KBr): 2940 *w*, 2880 *w*, 2820 *w*, 1610 *s*, 1515 *m*, 1495 *s*, 1435 *m*, 1420 *m*, 1400 *m*, 1370 *m*, 1325 *s*. – ^{1}H-NMR.: 1.60 (6 H, *s*); 3.06 (6 H, *s*); 6.76 (2 H, *d*, J = 9); 7.63 (1 H, *d*, J = 9); 8.16 (2 H, *d*, J = 9); ~8.2 (2 H, *m*). MS. (110°): 309 (M^+, 100), 294 (30), 263 (12), 248 (17), 147 (12), 115 (14).

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