

A FACILE SYNTHESIS OF INDOLINE-SYSTEMS INVOLVING AN INTRAMOLECULAR
CYCLISATION VIA ARYL CARBENES

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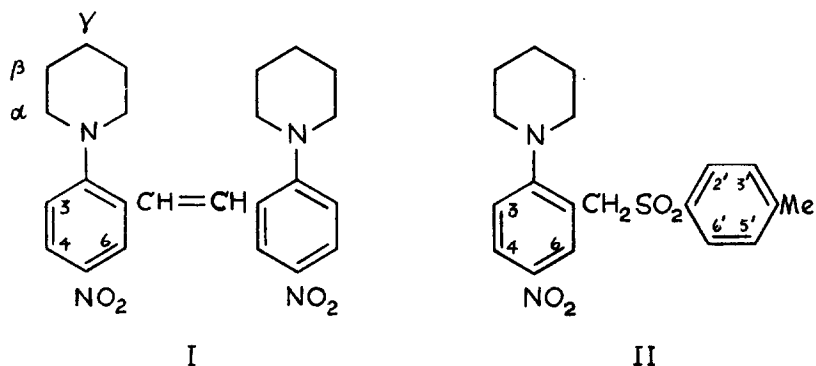
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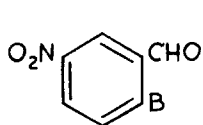
p-Toluenesulphonylhydrazones of benzaldehydes with an ortho-t-amine substituent, e.g. VI, decompose rapidly by the action of sodium methoxide in boiling diglyme (diethylene glycol dimethyl ether) to yield indolines, e.g. XII, in ca. 40% yield. This new application of the Bamford-Stevens reaction (1) undoubtedly involves an intramolecular insertion of the intermediate arylcarbene ($\text{Ar}-\overset{\ominus}{\text{C}}\text{H}$) rather than the alternative carbonium ion ($\text{Ar}-\overset{\oplus}{\text{C}}\text{H}_2$), since the former is the preferred mode of decomposition in non-hydroxylic solvents (2a). The carbene is produced on pyrolysis of the intermediate diazomethane (IX) obtained from the base-catalysed decomposition of the hydrazone (VI) (1,3). Direct decomposition, in boiling diglyme, of the diazomethane (IX) prepared in pyridine by Farnum's modification (4) resulted in a slightly improved overall yield of the indoline, although two stages are involved. In addition a small amount (4%) of the expected (5) olefin (I), decomp. $> 260^\circ$ (chemical shifts of τ 2.34, singlet (CH=CH); 6.08 (α -CH₂); 7.77 (β -CH₂); 8.04 (γ -CH₂); 1.34 (6-H); 1.49 (4-H); and

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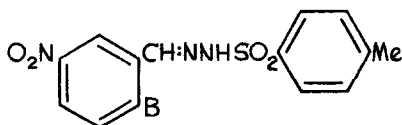
1.98 (3-H) with $J_{3/4} = 9.0$ c./sec. and $J_{4/6} = 2.5$ c./sec. in CF_3COOD) was obtained. As expected by analogy with the decomposition (1) of benzaldehyde tosylhydrazone, 5-nitro-2-piperidinobenzyl *p*-tolyl sulphone (II), m.p. 125° (chemical shifts of τ 8.43 ($[CH_2]_3$); 7.35 ($CH_2 \cdot N \cdot CH_2$); 7.60 (Me); 5.50 (CH_2SO_2); 2.98 (3-H); 1.87 (4-H); 1.66 (6-H); 2.50 (2',6'-H); and 2.74 (3',5'-H) with $J_{3/4} = 9$ c./sec., $J_{4/6} = 3$ c./sec. and $J_{2',3'} = 8.5$ c./sec. in $CDCl_3$) was obtained as a by-product (4%) from the decomposition of the hydrazone (VI).



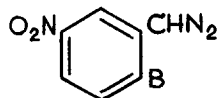
The benzaldehydes (III - V) were obtained by condensation of 2-chloro-5-nitrobenzaldehyde (6) with piperidine, dimethylamine and diethylamine respectively, in hot ethanol, and their reaction with *p*-toluenesulphonylhydrazide in ethanol yielded the hydrazones (VI) m.p. 179° , (VII) m.p. 182° , and (VIII) m.p. 129° . The diazomethane derivatives (IX - XI) had ν_{max} at 2070 cm^{-1} and were used without purification.



III, B = piperidino



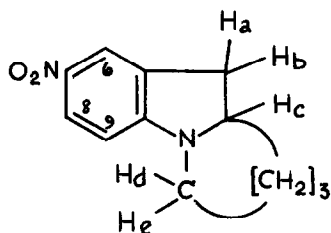
VI, B = piperidino



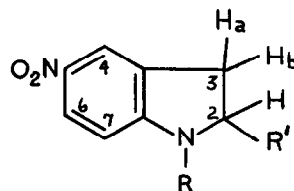
IX, B = piperidino

IV, B = NMe_2 VII, B = NMe_2 X, B = NMe_2 V, B = NEt_2 VIII, B = NEt_2 XI, B = NEt_2

The structure of the indoline (XII), m.p. 113^o, obtained from (VI) or (IX) followed from analysis and its n.m.r. spectrum (CDCl₃) which showed chemical shifts of τ 2.00 (8-H); 2.17 (6-H) and 3.80 (9-H) with $\underline{J}_{6/8} = 2.2$ c./sec. and $\underline{J}_{8/9} = 9.0$ c./sec. for the aromatic protons; and τ 8.0 - 8.7 ($[\text{CH}_2]_3$); ca. 7.1 (He); 6.2 - 6.6 (Hc and Hd overlapping); 6.93 (Hb); and 7.40 (Ha) with $\underline{J}_{a/b} = -15.8$ c./sec., $\underline{J}_{a/c} = 8.5$ c./sec. and $\underline{J}_{b/c} = 9.0$ c./sec.



XII



XIII, R = Me, R' = H

XIV, R = Et, R' = Me

1-Methyl-5-nitroindoline (XIII) obtained in a similar manner from (VII) or (X) had m.p. 126^o and chemical shifts of τ 7.12 (N-Me); 6.38 and 6.95 (A₂B₂ pattern, pyrroline ring); 2.17 (4-H); 1.98 (6-H) and 3.80 (7-H) with $\underline{J}_{4/6} = 2.2$ c./sec. and $\underline{J}_{6/7} = 8.5$ c./sec. in CDCl₃.

1-Ethyl-2-methyl-5-nitroindoline (XIV), the product from (VIII) or (XI), had chemical shifts (in CDCl₃) of τ 8.84 triplet and 6.70 quartet, $\underline{J} = 7.0$ c./sec. (N-Et); 8.70 doublet, $\underline{J} = 6.0$ c./sec. (2-Me); 5.98 multiplet (2-H); 6.80 and 7.38 (3-Ha and 3-Hb) with $\underline{J}_{a/b}$ (gem.) = -15.7 c./sec., $\underline{J}_{3a/2-H} = 7$ c./sec. and $\underline{J}_{3b/2-H} = 9$ c./sec.. The aromatic protons were at τ 2.18 (4-H), 1.99 (6-H), and 3.81 (7-H) with $\underline{J}_{4/6} = 2.2$ c./sec. and $\underline{J}_{6/7} = 8.8$ c./sec..

Analogous cyclisations, e.g. of 2-diazomethylbiphenyl to fluorene (2b) and of 1-diazoalkanes to cyclopropanes (7) are well known. This indoline cyclisation via carbenes may be compared with cyclisation of the

isoelectronic nitrenes, e.g. the formation of benzimidazoles from o-azido-phenyl heterocycles (8) which decompose to give dihydrobenzimidazoles initially (9), and also the pyrolysis of o-azidocumene and o-azidophenyl-cyclohexane which yield 3-methylindoline and hexahydrocarbazole respectively (10).

Further work on the general scope of the reaction by pyrolysis and by photolysis is in progress. All new compounds had correct analysis.

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