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One-pot Preparation of Derivatives of the Unknown 1,9-Diazaphenalene Ring by a Consecutive Electrocyclic Ring-closure/Claisen Rearrangement/Intramolecular Amination Process

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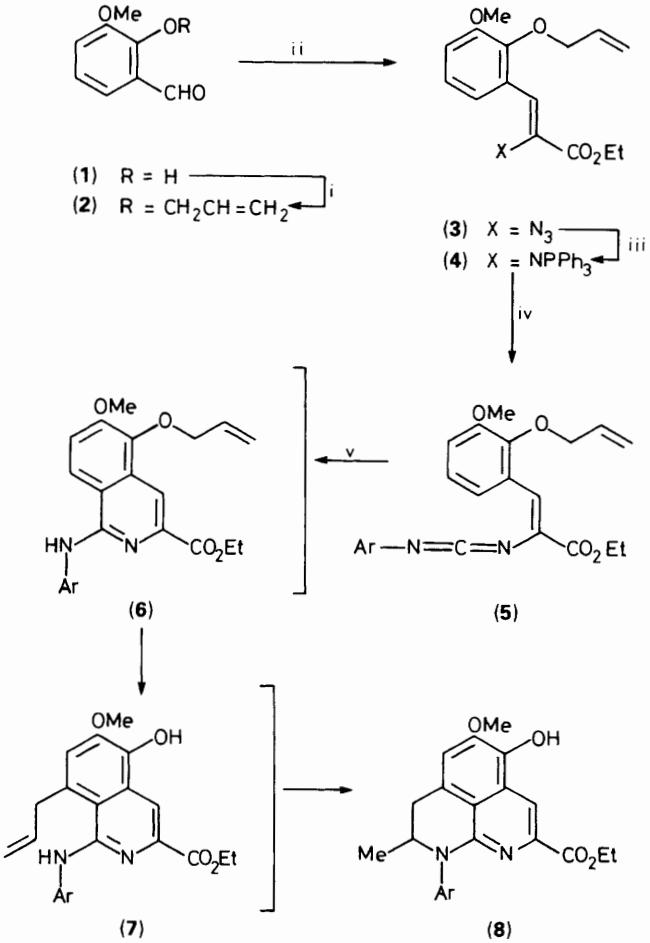
A short synthesis of 1,9-diazaphenalene derivatives (**8**) based on a new method of two consecutive pyridine annelations which involves cyclization of conjugated carbodiimides (**5**) is described.

Current interest in the chemistry of 1,8-naphthyridine derivatives has continued to grow because of their physiological activities and the behaviour of this ring system as a ligand.[1] The fusion of a benzene ring to the 1,8-naphthyridine system could result in three types of compound: diazaphenanthrenes, diaza-anthracenes, and diazaphenalenes. To the best of our knowledge only one member of the diazaphenalene system (1,6-diazaphenalene) has been described.[2] We now report an efficient synthesis of some derivatives of the unknown 1,9-diazaphenalene 1H-benzo[*d*,*e*][1,8]naphthyridine ring system, based on the strategy shown Scheme 1. This approach, which involves as key step a consecutive electrocyclic ring-closure/Claisen rearrangement/intramolecular amination process, has surprisingly been found to be useful in the construction of two fused pyridine rings.

The commercially available starting material, 2-hydroxy-3-methoxybenzaldehyde (**1**), was converted into the iminophosphorane (**4**) in 50% overall yield by standard chemistry: *O*-allylation ($BrCH_2CH{=}CH_2$, K_2CO_3, acetone, 70%), condensation with ethyl azidoacetate (NaOEt, EtOH, 60%), and Staudinger[3] reaction with triphenylphosphine (ether, room temp. 90%). Aza-Wittig type reaction between iminophosphorane (**4**) and aromatic isocyanates in dry toluene at room temperature led to the corresponding carbodiimides[4] (**5**) which at 150—160 °C furnish, after 12 h, crystalline solids identified as the dihydro-1*H*-1,9-diazaphenalenes† (**8**) in moderate yields (50—55%).

† Compound (**8b**) ^{1}H NMR (200 MHz, $CDCl_3$) δ 1.21 (d, 3H, *J* 6.5 Hz, 2-Me), 1.34 (t, 3H, *J* 7.0 Hz, *Me*CH_2), 2.35 (s, 3H, *Me*Ar), 2.86 (dd, 1H, *J* 3.3 and 15.8 Hz, 3-H_A), 3.51 (dd, 1H, *J* 5.0 and 15.8 Hz, 3-H_B), 3.96 (s, 3H, MeO), 4.27 (ddq, 1H, *J* 3.3, 5.0, and 6.5 Hz, 2-H), 4.30 (q, 2H, *J* 7.0 Hz, Me-CH_2), 4.80 (br. s, 1H, OH), 6.97 (s, 1H, 4-H), 7.19 (d, 2H, *J* 8.4 Hz, 2 H_o), 7.38 (d, 2H, *J* 8.4 Hz, 2 H_m), and 8.12 (s, 1H, 7-H); ^{13}C NMR δ (50 MHz, $CDCl_3$) 14.19 (*Me*CH_2), 18.35 (2-Me), 20.99 (*Me*Ar), 35.72 (C-3), 54.74 (C-2), 56.61 (MeO), 60.86 (*C*H_2Me), 108.69 (C-7), 111.61 (C-4), 126.39 (C_o), 129.18 (C_m), 112.83 (q), 124.94 (q), 126.61 (q), 134.69 (q), 138.51 (q), 140.24 (q), 141.48 (q), 145.10 (q), 153.09 (q), and 166.53 (CO). Values assigned by decoupling methods and 2D ^{1}H–^{13}C correlation techniques.



Scheme 1. *Reagents and conditions*: i, $BrCH_2CH{=}CH_2$, K_2CO_3, acetone, reflux; ii, $EtO_2CCH_2N_3$, NaOEt, EtOH, −15 °C; iii, PPh_3, ether, room temp.; iv, Ar–NCO, toluene, room temp., 1 h; v, sealed tube, toluene, 150—160 °C, 12 h.

Table 1. Yields of 1,9-diazaphenalenes (**8**).[a]

	Ar	% Yield
a	Ph	55
b	4-MeC_6H_4	52
c	4-$MeOC_6H_4$	50
d	4-ClC_6H_4	54
e	4-FC_6H_4	50

[a] All new compounds described here had spectral and microanalytical properties in agreement with the assigned structures.

The conversion (**5**) → (**8**) can be rationalized in terms of an initial electrocyclic ring closure followed by 1,3-proton shift to give the isoquinoline (**6**), which under the reaction conditions undergoes a Claisen rearrangement leading to (**7**). Finally, a 6-*exo-trig* intramolecular amination would lead to the 1,9-diazaphenalene (**8**). Although allylic carbon–carbon double bonds remote from a primary amino group can be used in cyclizations mediated by transition metal catalyst, *e.g.* palladium(0)-catalysed preparation of quinolines from *o*-allylamines,[5] this work shows for the first time that this type of reaction can be also achieved under thermal conditions.

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References

1 W. W. Paudler and R. M. Sheets, *Adv. Heterocycl. Chem.*, 1983, **33**, 147.
2 J. C. Chang, M. EI-Sheikh, and J. M. Cook, *Heterocycles*, 1979, **12**, 903.
3 H. Staudinger and J. Meyer, *Helv. Chim. Acta*, 1919, **2**, 635.
4 P. Molina, P. M. Fresneda, and P. Alarcón, *Tetrahedron Lett.*, 1988, 379.
5 L. S. Hegedus, G. F. Allen, J. J. Bozell, and E. L. Watterman, *J. Am. Chem. Soc.*, 1978, **100**, 5800.