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Photoreactions of 2-(*N*-Alkylarylamino)succinimides and Related Compounds

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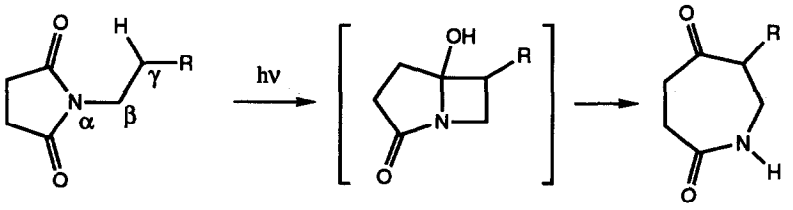
Abstract: *On irradiation (254 nm), 2-(*N*-methylanilino)-*N*-phenylsuccinimide (**6a**) underwent homolysis of the C(2)-N bond to yield fission products* N*-methylaniline and* N*-phenylsuccinimide (**12**), along with the products of* ortho- *and* para*-rearrangement 2-[2-(*N*-methylamino)phenyl]-*N*-phenylsuccinimide (**13**) and 2-[4-(*N*-methylamino)phenyl]-*N*-phenylsuccinimide (**14a**) respectively. Similarly, irradiation of 2-(*N*-methylanilino)succinimide (**6b**) and* N*-benzyl-2-(*N*-methylanilino)succinimide (**6c**) gave* N*-methylaniline and the corresponding products of* para*-rearrangement. In contrast, both fission and type II cyclisation photoproducts **12** and **17** respectively were formed from* N*-phenyl-2-(1,2,3,4-tetrahydroquinolin-1-yl)succinimide (**16**) and only the type II cyclisation product 1-hydroxy-2,7-diphenyl-2,7-diazabicyclo-[3.3.0]octan-3-one (**21**) was obtained from 2-(*N*-methylanilinomethyl)-*N*-phenylsuccinimide (**20**).*

The photochemistry of *N*-alkylsuccinimides and *N*-alkylphthalimides has been studied extensively during recent years.[1] One of the most common photoreactions is abstraction of hydrogen from the γ-position of the *N*-alkyl group, by one of the carbonyl oxygens, with subsequent cyclisation of the resulting biradical. In the case of succinimides **1**, this leads to a product **2** containing an unstable 2-hydroxyazetidine ring, and rearrangement to a stable azepine-2,5-dione follows. Similar photoreactions occur with *N*-alkylphthalimides.[1b] In view of these photoreactions and also of the successful photocyclisation of *N*-alkylarylaminomethyl aryl ketones (e.g. **4**, R = aryl) to azetidinols **5**,[3] we decided to investigate the photochemistry of 2-(*N*-methylanilino)succinimides **6** and related succinimides. A hydrogen abstraction-cyclisation sequence (type II cyclisation) similar to the reaction **1** → **2** would lead to interesting functionalised azetidines (e.g. **8**).

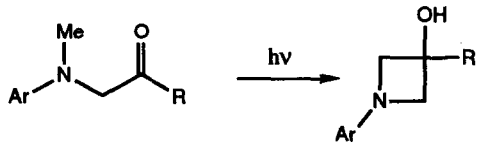


1 R = H, Me, Et **2** **3**

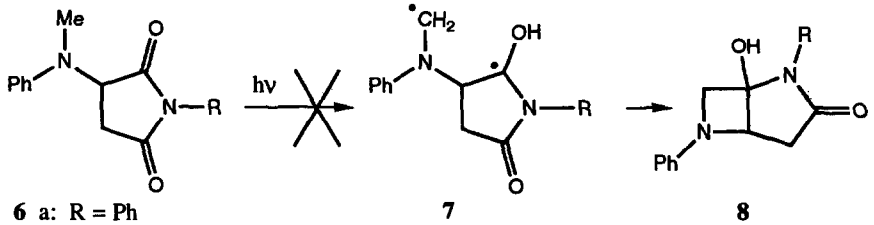
RESULTS

A series of 2-substituted succinimides, contained in quartz tubes, were irradiated using 254 nm lamps (see Experimental). The results are given in the Table. Irradiation of a 2% solution of succinimide **6a** in benzene/methanol yielded a complex mixture from which *N*-methylaniline (**11**) and a fraction, presumably consisting of *N*-phenylsuccinimide (**12**) and the product **14a** of *para*-rearrangement, were isolated. Treatment of this fraction with acetic anhydride yielded *N*-phenylsuccinimide and the *N*-acetyl derivative **15** of amine **14a**. When a more dilute solution (0.6%) of succinimide **6a** was irradiated, the product **13** of *ortho*-rearrangement was isolated, along with photoproducts **11** and **14a**, from the reaction mixture. Irradiation of the succinimides **6b** (in methanol) and **6c** (in benzene/methanol) also yielded *N*-methylaniline and the corresponding *para*- rearrangement products **14b** or **14c** respectively. In contrast, irradiation of the tetrahydroquinolinyl-succinimide **16** yielded the type II cyclisation product **17** as well as the fission product **12**. No significant products could be isolated from the complex photolysis mixtures obtained from the succinimide **18** and the maleimide **19**. Cyclisation to the 2,7-diazabicyclo-octanol **21** occurred in good yield on irradiation of the *N*-methylanilinomethyl-succinimide **20**, and fission photoproducts **12** and **23** were obtained from the tolylthio-succinimide **22**.

Preparation of succinimides **6**, **16**, **18**, **20** *and* **22** *and maleimide* **19**. - Succinimides **16** and **18** were obtained from the reaction of *N*-phenylmaleimide (**24**) with the appropriate secondary amine and succinimide **6c** was produced in a similar manner from *N*-benzylmaleimide and *N*-methylaniline. Treatment of 2-bromo-*N*-phenylmaleimide (**25**) with *N*-methylaniline in the presence of triethylamine yielded the maleimide **19**. Succinimide **20** was formed by addition of *N*-methylaniline to 2-methylene-*N*-phenylsuccinimide (**26**), the product of cyclisation of itaconic acid mono-anilide (**27**). Succinimides **6a**, **6b**, and **22** were prepared using literature procedures (see Experimental).

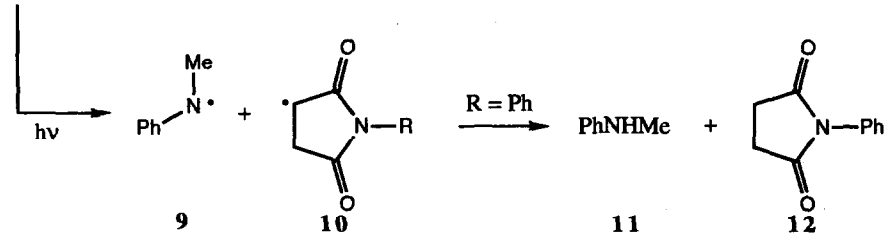


4 5 (R = aryl)

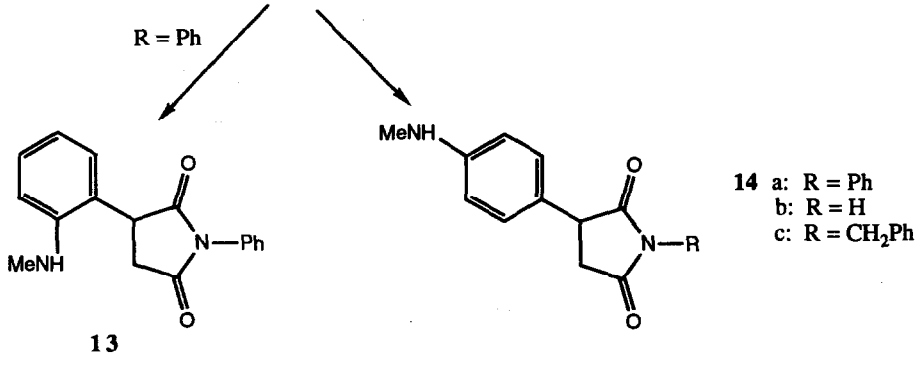


6 a: R = Ph
b: R = H
c: R = CH_2Ph

7 8



9 10 11 12

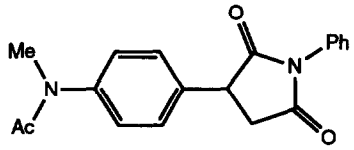


13 14 a: R = Ph
b: R = H
c: R = CH_2Ph

Table: Irradiation of 2-Substituted Succinimides.[a]

Succinimide	Solvent	Time (h)	Products (Yield %)[b]
6a	PhH/MeOH (1:1)[c]	15	**11** (23), **12** (12), **15** (10)[d] **6a** (45)
6a	PhH/MeOH (1:1)[e]	15	**11** (9), **13** (20), **14a** (9), **6a** (10)
6b	MeOH	12	**11** (12), **14b** (20), **6b** (10)
6c	PhH/MeOH (1:1)	10	**11** (20), **14c** (16), **6c** (11)
16	$CHCl_3$	8	**12** (36), **17** (20), **16** (41)
20	MeOH	21	**21** (80), **20** (50)
22	PhH	6	**12** (53), **23** (11), **22** (27)

[a] Irradiations were carried out on solutions contained in quartz tubes using a Rayonet RPR - 100 photoreactor fitted with 254 nm lamps.
[b] Yields are based on the amount of starting material consumed.
[c] 2% solution.
[d] After treatment with acetic anhydride.
[e] 0.67% solution.



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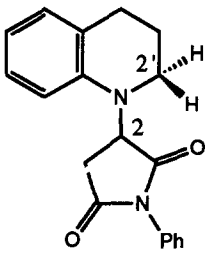

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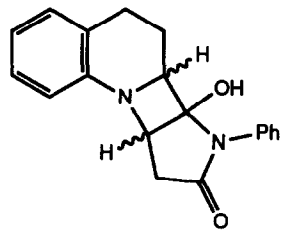

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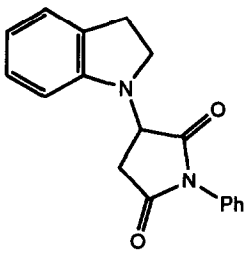

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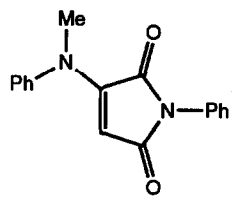

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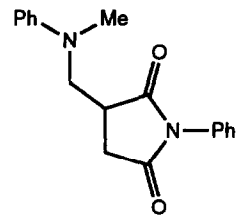

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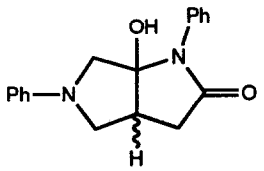
DISCUSSION

Unlike *N*-alkylsuccinimides **1**, which undergo type II cyclisation in moderate yields, the 2-*N*-methylanilinosuccinimides **6a** - **6c** cleave to radicals **9** and **10** on irradiation. In each case the fission product *N*-methylaniline (**11**) and radical-recombination product **14a** - **14c** respectively were formed. Only in the case of succinimide **16** was a type II cyclisation product, **17**, isolated from the reaction mixture. The lack of type II cyclisation by succinimides **6** probably reflects the relatively high strain in the transition state leading to biradical **7** or to product **8**, or both. This could result in C(2)-N bond cleavage, to radicals **9** and **10**, being the more favoured reaction pathway. This cleavage to radicals followed by recombination to give products of *ortho*- and/or *para*-rearrangement is similar to the photorearrangement[4] of aminoketones **4** (R = alkyl), which, unlike the corresponding aryl aminoketones **4** (R = aryl), do not undergo type II cyclisation.

In contrast to succinimides **6**, the tetrahydroquinolinyl-succinimide **16** undergoes both type II cyclisation to the azetidinol **17** as well as C(2)-N bond cleavage. In imide **16**, one of the two C(2') hydrogens is favourably placed for transfer to the adjacent carbonyl group and hence only rotation about the C(2)-N bond is required to bring the two interacting hydrogen and oxygen atoms near enough to each other for type II cyclisation to occur. In the case of succinimides **6**, rotation about both the C(2)-N and N-CH_3 bonds is required to achieve the conformation necessary for type II cyclisation and hence this reaction will be less favoured for these imides than it is for succinimide **16**. In succinimide **20**, strain in the transition states leading to product **21** is unlikely to be severe and photocyclisation to a 5-membered ring occurs readily. A related δ-hydrogen abstraction followed by cyclisation to a 5-membered ring was reported for the *N*-alkylsuccinimides **28**, which lack the C(γ) hydrogen necessary for type II cyclisation to a 4-membered ring.[5]



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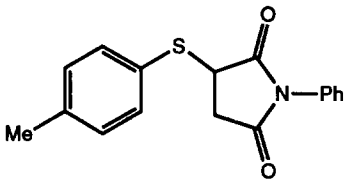

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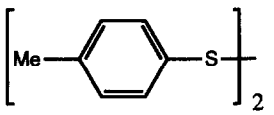

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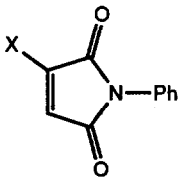
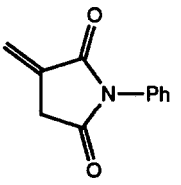


24 X = H
25 X = Br



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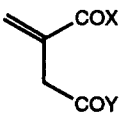
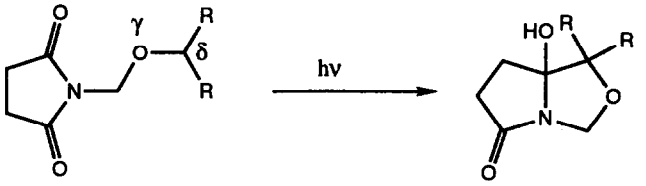


27 X = OH, Y = NHPh
or X = NHPh, Y = OH



28 R = Me or R,R = $(CH_2)_n$ (n = 4, 5, or 6)

EXPERIMENTAL

I.r. spectra were recorded as Nujol mulls (for solids) or as thin films (for oils) and n.m.r. spectra were recorded at 300 MHz with $CDCl_3$ as solvent unless otherwise stated. Electron impact mass spectral data are recorded except where the use of chemical ionisation (C.I.) is noted. 'Chromatography' refers to 'flash' column chromatography over Merck Kieselgel 60H and light petroleum had b.p. 60-80°C unless otherwise stated. The following compounds were prepared according to literature procedures: 2-(*N*-methylanilino)-*N*-phenylsuccinimide (**6a**),[6] 2-(*N*-methylanilino)succinimide (**6b**),[7] *N*-phenyl-2-(*p*-tolylthio)succinimide (**22**),[8] *N*-benzylmaleimide,[9] *N*-phenylmaleimide (**24**),[10] 2-bromo-*N*-phenylmaleimide (**25**),[11] itaconic acid mono-anilide (**27**),[12] *N*-phenylsuccinimide (**12**),[13] and di-*p*-tolyl disulphide (**23**).[14]

N-*Benzyl*-2-(N-*methylanilino)succinimide* (**6c**). - A solution of *N*-methylaniline (0.43 g) and *N*-benzylmaleimide (0.75 g) in glacial acetic acid (8 ml) was heated for 9 h on the water-bath. The resulting solid was collected and crystallised from light petroleum (b.p. 80-100°C) to give N-*benzyl*-2-(N-*methylanilino)succinimide* (0.58 g, 49%), m.p. 93°C (Found: C, 73.2; H, 6.1; N, 9.8. $C_{18}H_{18}N_2O_2$ requires C, 73.4; H, 6.2; N, 9.5%); $\nu_{max.}$ 1770 and 1695 cm^{-1}; δ 2.66 [1H, dd, *J* 5.6 and 18.5 Hz, C(3)-H], 2.74 (3H, s, NMe), 3.0 [1H, dd, *J* 9.0 and 18.5 Hz, C(3)-H], 4.69 and 4.71 (2 x 1H, doublets *J* 13.9 Hz, NCH_2), 4.80 [1H, dd, *J* 5.6 and 9.0 Hz, C(2)-H], 6.73-6.83 (3H, m, ArH), and 7.17-7.40 (7H, m, ArH); *m/z* 294 (M^+, 71%), 203 (18), 189 (14), 160 (39), 133 (61), 106 (100), 91 (79), 77 (51), 65 (17), and 51 (21).

N-*Phenyl*-2-(1,2,3,4-*tetrahydroquinolin*-1-*yl)succinimide* (**16**). - A solution of *N*-phenylmaleimide (1.93 g) and 1,2,3,4-tetrahydroquinoline (1.49 g) in glacial acetic acid (15 ml) was kept for 18 h at room temperature. The resulting precipitate was collected and crystallised from light petroleum (b.p. 80-100°C) to give N-*phenyl*-2-(1,2,3,4-*tetrahydroquinolin*-1-*yl)succinimide* (2.7 g, 79%), m.p. 195-197°C (Found: C, 74.5; H, 5.8; N, 9.0. $C_{19}H_{18}N_2O_2$ requires C, 74.5; H, 5.9; N, 9.1%); $\nu_{max.}$ 1765 and 1680 cm^{-1}; δ (90 MHz) 1.8-2.2 (2H, m, CH_2), 2.6-3.46 (6H, m, 3 x CH_2), 5.18 [1H, dd, *J* 6.5 and 9.0 Hz, C(2)-H], and 6.5-7.7 (9H, m, ArH).

2-(*Indolin*-1-*yl*)-N-*phenylsuccinimide* (**18**). - Indoline (1.9 g) was allowed to react with *N*-phenylmaleimide (2.56 g), using the procedure described in the preceding experiment, to give 2-(*indolin*-1-*yl*)-N-*phenylsuccinimide* (2.57 g, 59%), m.p. 118-120°C (from toluene) (Found: C, 73.9; H, 5.4; N, 9.4. $C_{18}H_{16}N_2O_2$ requires C, 74.0; H, 5.5; N, 9.6%); $\nu_{max.}$ 1780 and 1700 cm^{-1}; δ (90 MHz) 2.7-3.2 (4H, m, 2 x CH_2), 3.25-3.6 (2H, m, NCH_2), 4.88 [1H, dd *J* 6.5 and 9.0 Hz, C(2)-H], and 6.3-7.6 (9H, m, ArH).

2-(N-*Methylanilino)*-N-*phenylmaleimide* (**19**). - A solution of 2-bromo-*N*-phenylmaleimide (0.504 g), *N*-methylaniline (0.214 g), and triethylamine (0.35 ml) in dry xylene (5 ml) was heated under reflux for 1 h. The cooled mixture was extracted into ether and the ethereal extract was washed with water, dried, and evaporated. Chromatographic separation of the residual oil, eluting with 1:1 dichloromethane/light petroleum, yielded 2-(N-*methylanilino)*-N-*phenylmaleimide* (0.33 g, 60%) as a yellow oil (Found: M^+ 278.1055. $C_{17}H_{14}N_2O_2$ requires M^+ 278.1055); $\nu_{max.}$ 1760, 1712, and 1620 cm^{-1}; δ 3.56 (3H, s, NMe), 5.13 [1H, s, C(3)-H], and 7.28-7.44 (10H, m, ArH); *m/z* 278 (M^+, 100%), 249 (21), 158 (18), 131 (83), 116 (58), 106 (19), 91 (26), 77 (69), 65 (14), and 51 (38).

2-(N-*Methylanilinomethyl)*-N-*phenylsuccinimide* (**20**). - (i) A mixture of itaconic acid monoanilide (5 g), acetic anhydride (11 ml), and anhydrous sodium acetate (1.0 g) was heated on the water-bath until all the anilide had dissolved. The mixture was cooled, extracted into ether, and the extract was washed with 10% aqueous sodium hydroxide and then dried. After evaporation, the residue was chromatographed, eluting with 1:1 dichloromethane/light petroleum, to give 2-*methylene*-N-*phenylsuccinimide* (**26**) (2.7 g, 59%), m.p. 120°C (Found: C, 70.3; H, 4.9; N, 7.4. $C_{11}H_9NO_2$ requires C,

70.6; H, 4.8; N, 7.5%); $\nu_{max.}$ 1711 and 1665 cm^{-1}; δ 3.5 (2H, apparent t *J* 2.3 Hz, CH_2), 5.73 (1H, apparent t *J* 2.0 Hz, C=CH), 6.46 (1H, apparent t *J* 2.5 Hz, C=CH), and 7.24-7.50 (5H, m, Ph); *m/z* (C.I.) 188 [$(M + H)^+$, 12%], 187 (M^+, 100), 159 (6), 130 (16), 119 (15), 91 (26), 77 (13), 68 (93), and 64 (27).

(ii) A solution of 2-methylene-*N*-phenylsuccinimide (2.0 g) and *N*-methylaniline (1.25 g) in glacial acetic acid (20 ml) was heated under reflux for 18 h. The mixture was cooled, extracted into ether, and the ethereal extract was washed with 10% aqueous sodium hydroxide, dried, and evaporated. Chromatographic separation, eluting with 3:1 light petroleum/ethyl acetate, gave 2-(N-*methylanilino-methyl)*-N-*phenylsuccinimide* (1.1 g, 35%) as an oil (Found: C, 72.9; H, 6.4; N, 9.1. $C_{18}H_{18}N_2O_2$ requires C, 73.4; H, 6.2; N, 9.5%); $\nu_{max.}$ 1777 and 1712 cm^{-1}; δ 2.76 (1H, dd, *J* 5.3 and 18.4 Hz) and 2.92 (1H, dd, *J* 9.1 and 18.4 Hz) [C(3)H_2], 3.0 (3H, s, NMe), 3.30-3.36 [1H, m, C(2)-H], 3.68 (1H, dd *J* 9.1 and 15.0 Hz) and 4.0 (1H, dd *J* 5.0 and 15.0 Hz) (NCH_2), and 6.75-6.80 and 7.22-7.49 (10H, multiplets, ArH); *m/z* 294 (M^+, 6%), 120 (100), 104 (7), 91 (5), 77 (13), and 55 (6).

Irradiation of 2-*Substituted Succinimides*

A solution of the succinimide contained in a quartz tube was irradiated in a Rayonet RPR-100 photoreactor fitted with 254 nm lamps. The solvent was evaporated and the products were generally isolated by 'flash' column chromatography over silica gel.

Irradiation of 2-(N-*methylanilino*)-N-*phenylsuccinimide* (**6a**). - (i) A solution of imide **6a** (1.2 g) in 1:1 benzene/methanol (60 ml) was irradiated for 15 h. Chromatography (at atmospheric pressure) of the product mixture over Hopkin & Williams silica gel M.F.C., eluting with toluene, yielded *N*-methylaniline (58 mg). Further elution with 19:1 toluene/ethyl acetate gave a mixture (180 mg) of *N*-phenylsuccinimide (**12**) and 2-[4-(*N*-methylamino)phenyl]-*N*-phenylsuccinimide (**14a**); $\nu_{max.}$ 3400, 1770, and 1690 cm^{-1}; δ (product **12**) 2.79 (4H, s, 2 x CH_2) and 7.0-7.5 (5H, m, Ph); δ (product **14a**) 1.7 (1H, broad signal, NH), 2.78 (3H, s, NMe), 2.92 [1H, dd *J* 4.7 and 18.5 Hz, C(3)-H], 3.30 [1H, dd *J* 9.5 and 18.5 Hz, C(3)-H], 4.04 [1H, dd *J* 4.7 and 9.5 Hz, C(2)-H], 6.57-6.60 and 7.07-7.1 (4H, AA'BB'm, C_6H_4), and 7.1-7.7 (5H, m, Ph); *m/z* (C.I.) 298 [$(M + NH_4)^+$, 3%] and 281 [$(M + H)^+$, 3] (*M* refers to product **14a**).

The above mixture of **12** and **14a** (160 mg) was heated under reflux for 5 min. with acetic anhydride (1 ml). Water (*ca.* 3 ml) was added and the mixture was heated to the boil and then cooled. Filtration yielded 2-[4-(N-*acetyl*-N-*methylamino)phenyl*]-N-*phenylsuccinimide* (**15**) (65 mg) (Found: M^+ 322.1318. $C_{19}H_{18}N_2O_3$ requires M^+ 322.1317); $\nu_{max.}$ 1780 and 1700 cm^{-1}; δ (90 MHz) 1.92 (3H, s, COMe), 3.25 (3H, s, NMe), 2.8-3.4 (2H, m, CH_2), 4.25 (1H, dd *J* 6 and 10 Hz, CH), and 6.5-8.0 (9H, m, ArH). Evaporation of the filtrate gave *N*-phenylsuccinimide (**12**) (45 mg).

(ii) The imide **6a** (1.0 g) in 1:1 benzene/methanol (150 ml) was irradiated for 15 h. Chromatography of the photoproduct mixture, eluting with 3:1 light petroleum/ethyl acetate, gave first *N*-methylaniline (30 mg) and then imide **6a** (0.1 g). Further elution with 2:1 light petroleum/ethyl acetate yielded first 2-[4-(N-*methylanilino)phenyl*]-N-*phenylsuccinimide (14a*) (80 mg) (Found: M^+ 280.1221. $C_{17}H_{16}N_2O_2$ requires M^+ 280.1212); $\nu_{max.}$ 3410, 1767, and 1705 cm^{-1}; δ 2.87 (3H, s, NMe), 3.13

[1H, dd *J* 6 and 18 Hz, C(3)-H], 3.20 [1H, dd *J* 9 and 18 Hz, C(3)-H], 4.45 [1H, dd *J* 6 and 9 Hz, C(2)-H], 6.64-6.67 and 7.57-7.60 (4H, AA'BB'm, C_6H_4), and 7.3-7.5 (5H, m, Ph); *m/z* 280 (M^+, 4%), 187 (10), 160 (42), 145 (68), 120 (14), 111 (9), 102 (100), 84 (31), 73 (67), 65 (15), and 57 (43). Further elution gave 2-[2-(N-*methylamino)phenyl*]-N-*phenylsuccinimide* (**13**) (0.18 g) (Found: M^+ 280.1223. $C_{17}H_{16}N_2O_2$ requires M^+ 280.1212); $\nu_{max.}$ 3315, 1695, and 1614 cm^{-1}; δ 2.7 [1H, dd *J* 6.7 and 15.7 Hz, C(3)-H], 3.03 [1H, dd *J* 6.7 and 15.7 Hz, C(3)-H], 3.18 (3H, s, NMe), 3.89 [1H, t *J* 6.7 Hz, C(2)-H], 6.80-7.55 (9H, m, ArH), and 9.13 (1H, s, NH); *m/z* 280 (M^+, 17%), 187 (5), 159 (100), 145 (6), 131 (14), 117 (12), 92 (22), 77 (19), and 65 (16).

Irradiation of 2-(N-*Methylanilino)succinimide* (**6b**). - A solution of imide **6b** (1.0 g) in methanol (70 ml) was irradiated for 12 h. Chromatography of the photoproduct mixture, eluting with 4:1 light petroleum/ethyl acetate, gave *N*-methylaniline (56 mg). Elution with 3:1 light petroleum/ethyl acetate gave imide **6b** (0.1 g) and elution with 2:1 light petroleum/ethyl acetate yielded a solid (0.2 g) which on crystallisation from toluene gave 2-[4-(N-*methylamino)phenyl]succinimide* (**14b**) (0.18 g), m.p. 150-151°C (Found: C, 64.55; H, 6.2; N, 13.7. $C_{11}H_{12}N_2O_2$ requires C, 64.7; H, 5.9; N, 13.7%); $\nu_{max.}$ 3350, 1768, and 1705 cm^{-1}; δ 2.52 [1H, dd *J* 5.0 and 18.4 Hz, C(3)-H], 2.59 (3H, s, NMe), 2.94 [1H, dd *J* 9.6 and 18.4 Hz, C(3)-H], 3.68 [1H, dd *J* 5.0 and 9.6 Hz, C(2)-H], 3.96 (1H, broad s, NH), 6.36-6.39 and 6.81-6.84 (4H, AA'BB'm, C_6H_4), and 10.62 (1H, broad s, NHCO); *m/z* 204 (M^+, 48%), 133 (100), 131 (47), 91 (10), 77 (19), 66 (49), 65 (28), 53 (19), and 51 (17).

Irradiation of N-*Benzyl*-2-(N-*methylanilino)succinimide* (**6c**). - A solution of imide **6c** (1.2 g) in 1:1 benzene/methanol (60 ml) was irradiated for 10 h. Chromatography of the photoproduct mixture, eluting with 1:1 cyclohexane/dichloromethane, gave *N*-methylaniline (79 mg). Further elution with 1:2 cyclohexane/dichloromethane yielded first imide **6c** (0.13 g) and then an impure fraction which was rechromatographed to give N-*benzyl*-2-[4-(N-*methylamino)phenyl]succinimide* (**14c**) (0.17 g) (Found: M^+ 294.1324. $C_{18}H_{18}N_2O_2$ requires M^+ 294.1368); $\nu_{max.}$ 3400, 1770, and 1690 cm^{-1}; δ 1.7 (1H, broad signal, NH), 2.74 [1H, dd *J* 4.7 and 18.5 Hz, C(3)-H], 2.80 (3H, s, NMe), 3.13 [1H, dd *J* 9.5 and 18.5 Hz, C(3)-H], 3.89 [1H, dd *J* 4.7 and 9.5 Hz, C(2)-H], 4.65 and 4.69 (2 x 1H, doublets *J* 14 Hz, CH_2), 6.61-6.64 and 6.94-6.97 (4H, AA'BB'm, C_6H_4), and 7.22-7.37 (5H, m, Ph); *m/z* 294 (M^+, 59%), 161 (14), 133 (100), 132 (53), 91 (26), 77 (16), 65 (12), and 49 (13).

Irradiation of N-*Phenyl*-2-(1,2,3,4-*tetrahydroquinolin*-1-*yl)succinimide* (**16**). - A solution of imide **16** (1.4 g) in chloroform (60 ml) was irradiated for 8 h. Chromatography of the photoproduct mixture, eluting with 9:1 chloroform/ethyl acetate, yielded first imide **16** (0.573 g), then *N*-phenylsuccinimide (**12**) (171 mg), and finally the *pyrrolo-azetoquinoline* **17** (168 mg), m.p. 145-147°C (from methanol) (Found: C, 74.0; H, 6.2; N, 9.0. $C_{19}H_{18}N_2O_2$ requires C, 74.5; H, 5.9; N, 9.1%); $\nu_{max.}$ 3300, 1687, and 1670 cm^{-1}; δ (90 MHz) 1.6-2.2 (2H, m, CH_2), *ca.* 2.6-3.1 (4H, m, $ArCH_2$ and CH_2CO), *ca.* 3.5-4.1 (2H, m, 2 x NCH), 6.7-7.9 (9H, m, ArH), and 9.2 (1H, s, OH); *m/z* 306 (M^+, 80%), 213 (26), 186 (85), 185 (100), 184 (34), 172 (29), 158 (44), 156 (42), and 130 (31).

Irradiation of 2-(N-*Methylanilinomethyl*)-N-*phenylsuccinimide* (**20**). - A solution of imide **20** (1.0 g) in methanol (200 ml) was irradiated for 21 h. Chromatography of the photoproduct mixture, eluting with 3:1 light petroleum/ethyl acetate, gave imide **20** (0.5 g). Further elution with 1:2 light petroleum/ethyl acetate yielded 1-*hydroxy*-2,7-*diphenyl*-2,7-*diazabicyclo*[3.3.0]*octan*-3-*one* (**21**) (0.4 g), m.p. 146-147°C (from toluene) (Found: C, 73.3; H, 6.3; N, 9.2. $C_{18}H_{18}N_2O_2$ requires C, 73.4; H, 6.2; N, 9.5%); $\nu_{max.}$ 3330 and 1680 cm^{-1}; δ 2.30-2.39 (1H, m, CH), 2.81-2.93 (2H, m, CH_2), 3.15-3.2 (1H, m, CH), 3.27 and 3.53 [2 x 1H, doublets *J* 10.6 Hz, C(8)H_2], 3.67-3.73 (1H, m, CH), 4.45 (1H, broad signal, OH), 6.43-6.51 and 6.64-7.38 (10H, multiplets, 2 x Ph); *m/z* (C.I.) 295 [$(M + H)^+$, 100%], 251 (15), 120 (16), 106 (9), and 94 (39).

Irradiation of N-*Phenyl*-2-(p-*tolylthio*)*succinimide* (**22**). - A solution of imide **22** (1.0 g) in benzene (100 ml) was irradiated for 6 h. Chromatography of the photoproduct mixture, eluting with chloroform, yielded di-*p*-tolyl disulphide (**23**) (35 mg). Further elution with 9:1 chloroform/ethyl acetate gave imide **22** (0.27 g) and then *N*-phenylsuccinimide (**12**) (0.23 g).

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