Nitrogen Heterocycles. Part 6.[1] Conversion of 3-(α-Bromobenzylidene)-2-phenethylphthalimidine into Pyrrole and Benzazepine Derivatives; Base-catalysed Rearrangement and Photolysis of 3-(α-Bromobenzylidene)phthalimidine

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3-Benzyl-3-hydroxy-2-phenethylphthalimidine (1) can be converted into (*E*)- and (*Z*)-3-benzylidene-2-phenethylphthalimidines, (2) and (3). Bromination of (2) and/or (3) affords a mixture of (*Z*)- and (*E*)-3-(α-bromobenzylidene)-2-phenethylphthalimidines, (4) and (5), in the ratio 67 : 33. The latter compounds cyclise on treatment with alkali to give a mixture of 7,8-dihydro-13-phenyl-5*H*-isoindolo[1,2-*b*][3]benzazepin-5-one (6), *o*-(3,4-diphenylpyrrol-2-yl)benzoic acid (7), and 1,2,3,9b-tetrahydro-1,2-diphenyl-5*H*-pyrrolo[2,1-*a*]isoindol-5-one (8). Photolysis of the phthalimidines (4) and (5) in methanol gives the isoindolobenzazepinone (6) only. When (*Z*)-3-(α-bromobenzylidene)phthalimidine (17) is treated with base in boiling ethylene glycol, conversion into 4-(β-hydroxyethoxy)-3-phenylisoquinolin-1(2*H*)-one (18) takes place, and into the 4-[β-(β-hydroxyethoxy)ethoxy] derivative (20) when diethylene glycol is used as solvent. Photolysis of (17) in methanol leads to (*Z*)-3-(α-methoxybenzylidene)phthalimidine (22). In the light of the results obtained with the phthalimidine (17), the transformations promoted by the action of base seem to involve a carbenoid intermediate.

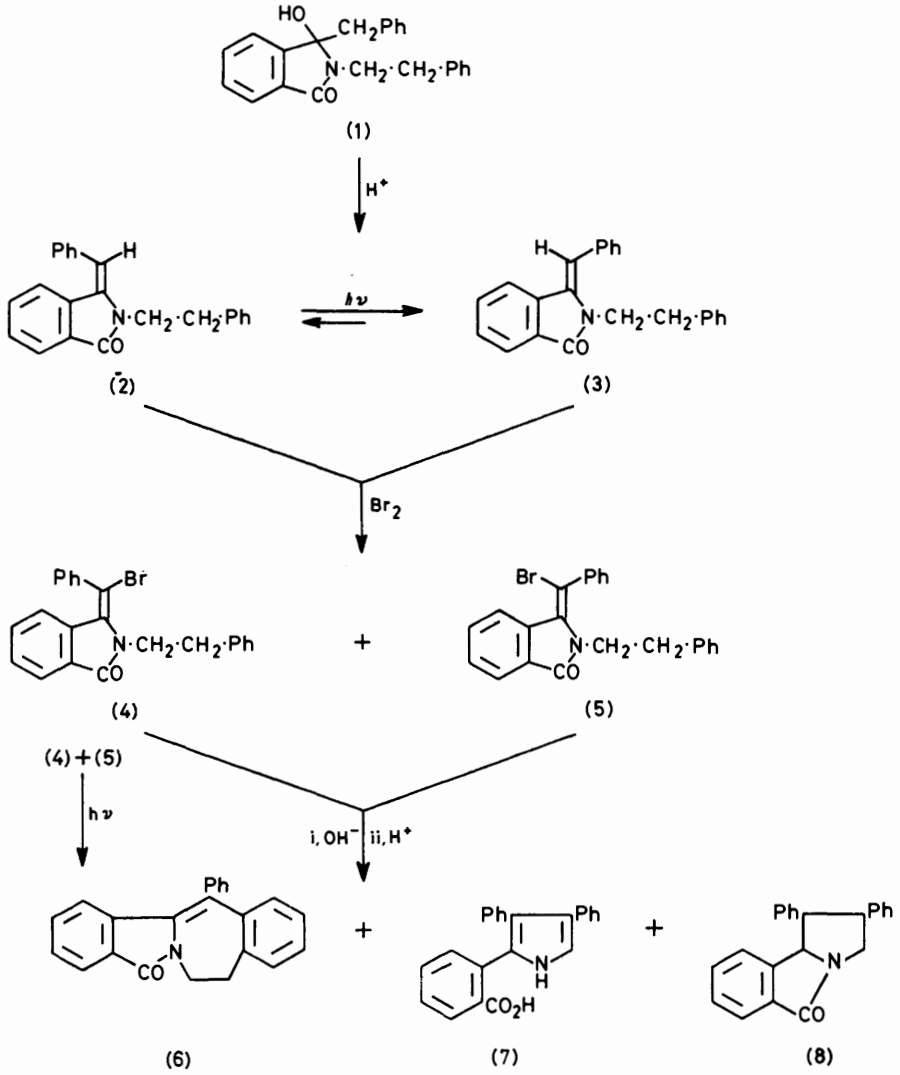
THE unusual transformations of 2-benzyl-3-(α-bromobenzylidene)phthalimidine [1,2] prompted us to study the behaviour of other compounds of the same series. Preliminary results obtained with 3-(α-bromobenzylidene)-2-phenethylphthalimidine have been briefly described.[3] Full experimental details and further work are described in this paper. In the hope of obtaining information

[1] Part 5, A. Marsili and V. Scartoni, *Gazzetta*, 1974, **104**, 165.
[2] A. Marsili and V. Scartoni, *Tetrahedron Letters*, 1968, 2511.
[3] A. Marsili and V. Scartoni, *Tetrahedron Letters*, 1969, 887.

about the mechanism of the base-promoted reactions the behaviour of the parent compound, 3-(α-bromobenzylidene)phthalimidine, has been investigated also.

RESULTS

(A) *Synthesis and Stereochemistry of the* N-*Phenethylphthalimidines* (*Scheme* 1).—Structure (1) was attributed to the adduct from phenethylamine and 3-benzylidenephthalide, mainly from comparison of its i.r. spectrum with those of similar compounds.[4] Dehydration of the adduct (1) with hydrochloric acid in ethanol * led to (*E*)-3-benzylidene-2-phenethylphthalimidine (2). The product contained about 5% of the (*Z*)-isomer (3), which was, however, obtained in moderate yield by exposure of (2) to sunlight. Although the products (2) and (3) contain, respectively, a *cis*- and a *trans*-stilbene system, owing possibly to lack of coplanarity between the benzylidene phenyl group and the condensed phthalimidine benzene ring in the *Z*-isomer the u.v. spectra were not helpful in assignment of configurations, the differences in positions of maxima and absorbances being too small. The problem was however solved by n.m.r. spectroscopy. Thus, on the basis of previous



SCHEME 1

results [5] the *E*-configuration was assigned to the isomer whose vinylic proton resonated at higher field. Moreover, each of the two multiplets arising from the methylene protons of the *E*-isomer † appeared at lower

* When more drastic conditions were used (for instance hydrochloric acid in boiling acetic acid) a Pictet–Spengler cyclisation took place, leading to 12b-benzyl-5,12b-dihydroisoindolo[1,2-*a*]-isoquinolin-8(6*H*)-one. This cyclisation is very rapid and easy when the phenyl group of the phenethyl group is oxygenated (see also H. O. Bernhard and V. Snieckus, *Tetrahedron Letters*, 1971, 48 67)

† It is assumed here that the CO–N–C*H*$_2$ protons are more deshielded than the benzylic protons (see, for instance, L. M. Jackman and S. Sternhell, 'Applications of NMR Spectroscopy in Organic Chemistry,' 2nd edn., Pergamon, Oxford, 1969, pp. 63—72).

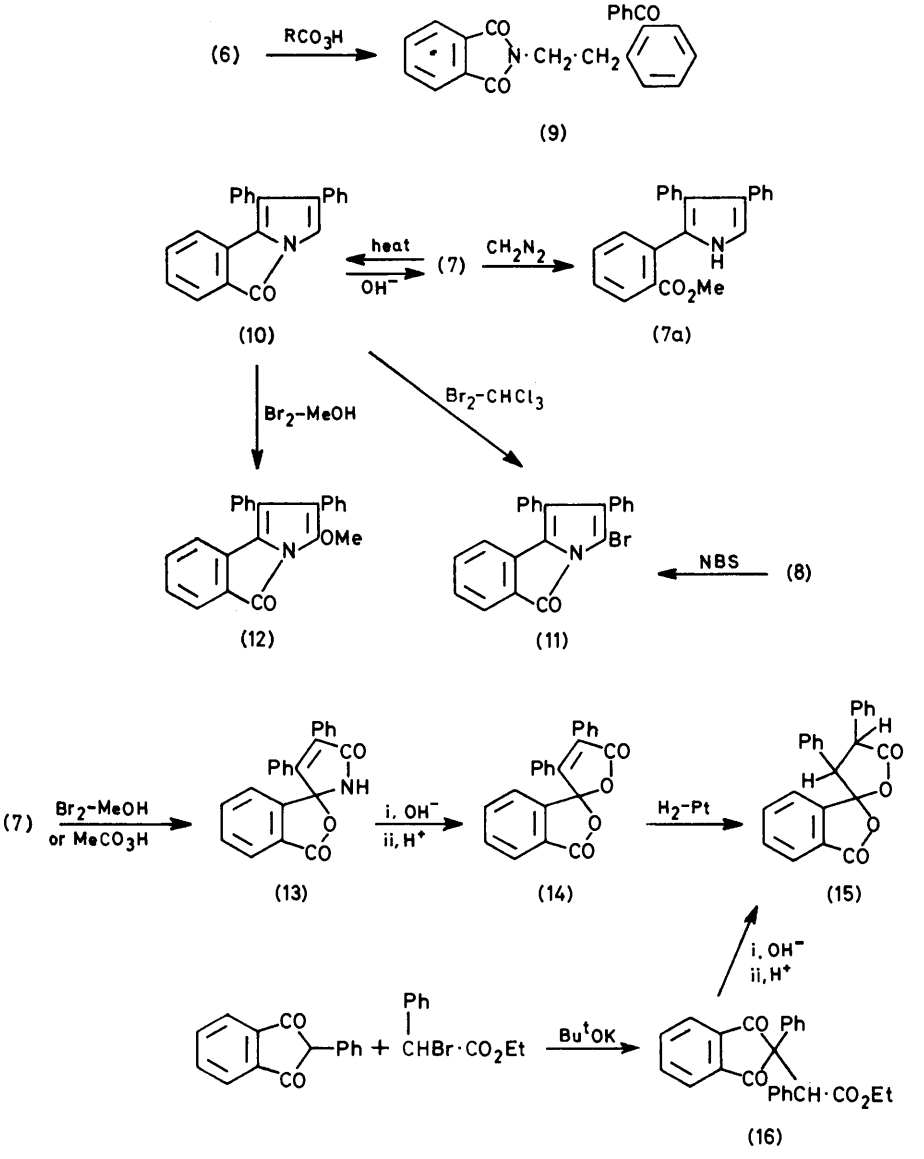
[4] A. Marsili and V. Scartoni, *Gazzetta*, 1972, **102**, 507.
[5] A. Marsili and V. Scartoni, *Gazzetta*, 1972, **102**, 806.

field with respect to the corresponding signal of the *Z*-isomer.

Bromination of either isomer (2) or (3) afforded an equilibrium mixture containing the bromo-derivatives (4) and (5) in the ratio 67 : 33. The two isomers could easily be separated by fractional crystallisation. In this case also n.m.r. spectroscopy was used for assignment of configuration. In the *Z*-isomer the two methylene groups give two multiplets at lower field with respect to the corresponding signals of the *E*-isomer. Moreover, in the spectra of both compounds one aromatic proton gives a doublet completely separated from the other aromatic signals: at δ 6.01 for (4) and 8.71 for (5). In accord with previous results [5] the shifted signal can be assigned to the H-4, which in (4) appears to be shielded by the benzylidene phenyl group, and in (5) deshielded by the bromine atom.

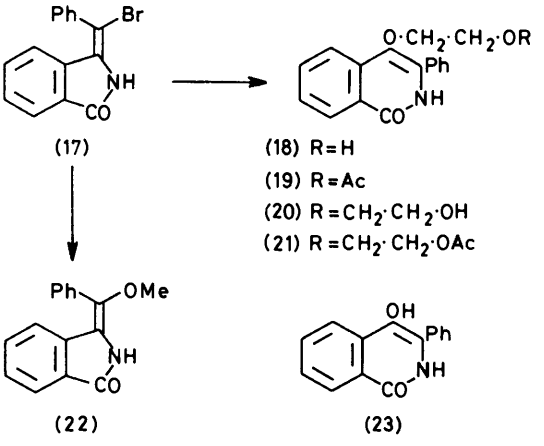
(B) *Cyclisation of the* N-*Phenethylphthalimidines* (*Scheme* 1) *and Proof of Structures* (*Scheme* 2).—When the two bromides (4) and (5) (or a mixture of the two) were heated with potassium hydroxide in ethylene glycol, compounds (6)—(8) were obtained as the main products. From irradiation of the mixture of (4) and (5) in methanol with sunlight, only (6) was isolated.

The identification of (6) was based mainly on its spectral characteristics. The position of the carbonyl stretching i.r. band (1 695 cm^{-1}) agrees with the presence of the phthalimidine moiety.[4] A more extended conjugation than in compounds (2)—(5) (*i.e.* the presence of a new ring) was deduced both from the bathochromic shifts of u.v. maxima, and from the n.m.r. spectrum, which shows a more complex aromatic resonance. In addition, one aromatic proton appears to be strongly shielded [δ 5.67 (d)]: the phenyl group at C-13, being



SCHEME 2

probably oriented out of the plane of the isoindolobenzazepine system, is presumably responsible for this effect. A similar situation has also been found in an isoindoloisoquinoline derivative.[1] Treatment of the product (6) with *p*-nitroperbenzoic acid afforded the phthalimide (9).



SCHEME 3

Some reactions of the pyrrole derivative (7), performed for its identification, are summarised in Scheme 2. Pyrolysis or treatment with acetic anhydride gave the pyrroloisoindolone (10) which, on basic hydrolysis, was reconverted into (7). Bromination of (10) in chloroform afforded the bromo-derivative (11), whereas bromination in methanol gave the methoxy-derivative (12). Treatment of (7) with an excess of bromine in either methanol or wet chloroform, or else with peracetic acid, resulted in the spiran (13) which, on treatment with base, followed by acidification, gave the dilactone (14). This compound was hydrogenated to (15), whose structure was confirmed by synthesis, following Rădulescu's method.[6]

The presence of the phthalimidine moiety in the pyrrolidine derivative (8) was deduced, as in the case of (6), from the position of the carbonyl stretching i.r. band (1 692 cm^{-1}), the n.m.r. spectrum (see Experimental section) and the easy conversion into the bromo-derivative (11) by *N*-bromosuccinimide.

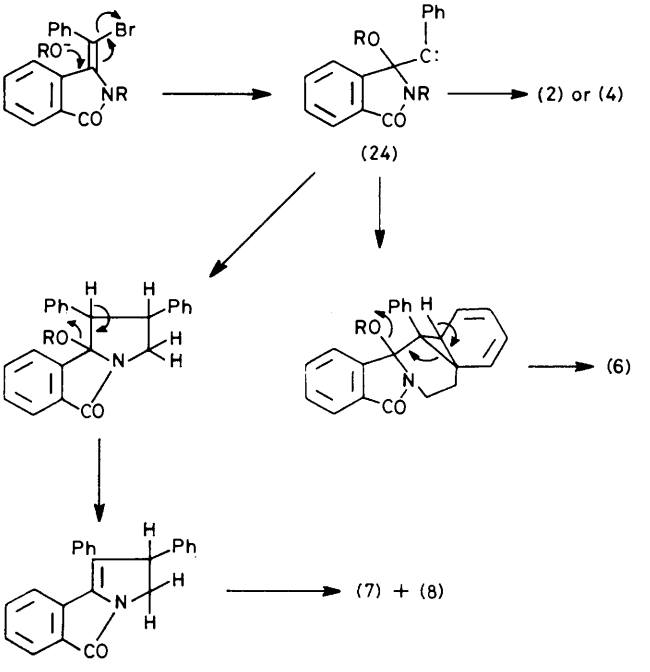
(C) *Results from* (Z)-3-(α-*Bromobenzylidene*)*phthalimidine* (17) (*Scheme* 3).—Treatment of compound (17) [5] at reflux with sodium acetate (or potassium hydroxide) in ethylene glycol gave a substance whose chemical properties, elemental analysis, and n.m.r. spectrum indicated that the reaction scheme could be represented stoicheiometrically as follows: $C_{15}H_{10}NOBr$ (17) + OH^- + $(CH_2{\cdot}OH)_2$ ⟶ $C_{15}H_{10}NO(O{\cdot}CH_2{\cdot}CH_2{\cdot}OH)$ (18) + H_2O + Br^-. That the process had not involved a mere substitution of the bromine atom of (17) by a β-hydroxyethoxy-group was ruled out on the basis of the i.r. spectrum of the product, in which the carbonyl stretching absorption band appears at lower frequency (1 634 cm^{-1}) with respect to the corresponding band of (17) (1 706 cm^{-1}, typical of phthalimidines [4]). Thus, it was deduced that the original five-membered heterocycle had undergone ring opening or, more probably, ring enlargement; one of the more probable structures appeared to be (18). The correctness of this hypothesis was confirmed by the easy conversion into the known 4-hydroxy-3-phenylisoquinolin-1(2*H*)-one (23) [7] by treatment with hydroiodic acid at reflux.

The (β-hydroxyethoxy)ethoxy-derivative (20) was obtained by using diethylene glycol as solvent for the base-catalysed rearrangement of (17).

When compound (17) was photolysed in methanol, 3-(α-methoxybenzylidene)phthalimidine (22) was formed. Its identification rests mainly on elemental analysis, n.m.r. spectrum, and the position of the carbonyl stretching i.r. band. The *Z*-configuration was tentatively attributed on the basis of the n.m.r. spectrum, which shows an aromatic signal at δ 6.67: this is very probably due to H-4, which should be shielded by the benzylidene phenyl group. Shielding effects of this kind have been observed and discussed in the case of similar compounds.[5]

DISCUSSION

As already pointed out,[1] it is dangerous to speculate about the cyclisation and rearrangement mechanisms on the basis of only product and reagent structures.



SCHEME 4

Concerning the reaction with base, mechanisms involving either a benzylic carbanion or a vinylic free radical have been discussed already and ruled out, although not completely.[1-3]

The results obtained with compound (17), which rearranges to products by a route in which the solvent appears to participate, by attack by C-3, permit a

[6] D. Rădulescu and G. Gheorgiu, *Ber.*, 1929, **59**, 186.
[7] K. Schenker, *Helv. Chim. Acta*, 1968, **51**, 413.

tentative suggestion that the first step is a nucleophilic attack by solvent anion (RO^-) [on (4), (5), or (17)], leading to a carbenoid intermediate such as (24). This intermediate, in the case of (4) and (5), could undergo either addition to a phenyl double bond followed by rearrangement and loss of ROH to give (6), or insertion into the benzylic methylene system to give a pyrroline intermediate which could disproportionate to (7) and (8). In the case of (17), the intermediate carbene could rearrange directly to the isoquinolone derivative.

The probable mechanism of the conversion of (10) into (13) has been discussed already.[3]

EXPERIMENTAL

M.p.s were determined with a Kofler hot-stage apparatus; i.r. spectra were recorded for Nujol mulls with a Perkin-Elmer 137 spectrophotometer; u.v. spectra were determined for solutions in 95% ethanol with a Zeiss PMQ II spectrophotometer; n.m.r. spectra were recorded for solutions in $CDCl_3$ (unless otherwise indicated) with a JEOL C-60 HL or a Varian DA-60-IL spectrometer (Me_4Si as internal standard).

3-Benzyl-3-hydroxy-2-phenethylphthalimidine (1).—Phenethylamine (24.8 g) and 3-benzylidenephthalide (34.8 g) were refluxed in ethanol (200 ml) for 30 min. Addition of water to the hot solution caused precipitation of the *product* (1) (47.0 g), which crystallised from methanol as needles, m.p. 155—157° (Found: C, 80.35; H, 6.1; N, 4.2. $C_{23}H_{21}NO_2$ requires C, 80.45; H, 6.15; N, 4.1%), ν_{OH} 3 226, ν_{CO} 1 689 and 1 672 cm^{-1}.

(E)-3-Benzylidene-2-phenethylphthalimidine (2).—A solution of compound (1) (40.0 g) in ethanol (200 ml) and 6N-hydrochloric acid (40 ml) was refluxed for 1 h. The precipitate formed on cooling (34.4 g) crystallised from methanol as *needles*, m.p. 115—116° (Found: C, 85.1; H, 5.9; N, 4.2. $C_{23}H_{19}NO$ requires C, 84.9; H, 5.9; N, 4.3%), ν_{CO} 1 699 cm^{-1}, $\lambda_{max.}$ 221 (log ε 4.52), 268 (4.00), and 326 nm (4.15), δ 3.00 (2 H, m, PhCH_2), 4.05 (2 H, m, N·CH_2), and 6.34 (1 H, s, olefinic H).

(Z)-3-Benzylidene-2-phenethylphthalimidine (3).—A solution of the *E*-isomer (2) (3.0 g) in methanol (50 ml) was sealed in a soft-glass tube and kept in sunlight for 20 days (*ca.* 100 h). The solution was then evaporated to afford the *Z-isomer* (3) (1.75 g), which crystallised from methanol as prisms, m.p. 117—119° (Found: C, 84.95; H, 5.75; N, 4.0%), ν_{CO} 1 698 cm^{-1}, $\lambda_{max.}$ 222 (log ε 4.53), 269 (4.05), and 324 nm (4.15), δ 2.41 (2 H, m, PhCH_2), 3.83 (2 H, m, N·CH_2), and 6.71 (1 H, s, olefinic H). Concentration of the mother liquor gave a mixture of (2) and (3) (0.9 g), m.p. 110—116°.

(Z)- and (E)-3-(α-Bromobenzylidene)-2-phenethylphthalimidine, (4) and (5).—Bromine (6.5 ml) in chloroform (20 ml) was slowly added to a stirred solution of compound (2) (37.0 g) in chloroform (180 ml) at 0 °C. The mixture was washed with water and 2N-sodium carbonate, and evaporated to an oily residue, which on trituration with methanol solidified in part. The solid (35.5 g), which contained (4) and (5) in the ratio 67 : 33 (integration of the n.m.r. signals at δ 6.01 and 8.79) was fractionally crystallised from methanol to give in the first fractions pure (4), white *prisms*, m.p. 135—136° (Found: C, 68.2; H, 4.3; N, 3.3. $C_{23}H_{18}BrNO$ requires C, 68.3; H, 4.5; N, 3.45%), ν_{CO} 1 706 cm^{-1}, $\lambda_{max.}$ 220 (log ε 4.54), 268 (4.04), and 328 nm (4.12), δ 3.12 (2 H, m, PhCH_2), 4.59 (2 H, m, N·CH_2), and 6.01 (1 H, d, H-4). The last fractions contained (5), which crystallised from methanol as pale pink prisms, m.p. 116—117° (Found: C, 68.0; H, 4.2; N, 3.35%), ν_{CO} 1 698 cm^{-1}, $\lambda_{max.}$ 224 (log ε 4.50), 268 (4.00), and 332 nm (413), δ 2.50 (2 H, m, PhCH_2), 3.49 (2 H, m, N·CH_2), and 8.79 (1 H, d, H-4).

Rearrangement of the Phthalimidines (4) and (5) with Alkali.—The crude mixture of (4) and (5) (18.0 g) was refluxed for 30 min with ethylene glycol (70 ml) containing potassium hydroxide (7.0 g). The mixture was then diluted with water (300 ml), cooled to room temperature, and thoroughly extracted with ether. Evaporation of the combined extracts gave an oily residue (*ca.* 12 g; containing ethylene glycol), which was dissolved in benzene and chromatographed over neutral alumina (250 g; grade I) with benzene as eluant (25 ml fractions). The first fractions contained pure *7,8-dihydro-13-phenyl-5H-isoindolo*[1,2-b]-[3]*benzazepin-5-one* (6) (2.2 g), which crystallised from methanol as light yellow prisms, m.p. 203—205° (Found: C, 85.4; H, 5.5; N, 4.25. $C_{23}H_{17}NO$ requires C, 85.4; H, 5.3; N, 4.35%), ν_{CO} 1 695 cm^{-1}, $\lambda_{max.}$ 292 (log ε 3.87) and 356 nm (4.38), δ 3.31 (2 H, m, PhCH_2), 4.20 (2 H, m, N·CH_2), and 5.67 (1 H, d, H-1). The intermediate fractions contained mixtures of (6) and (8) (1.8 g), and the last ones pure *1,2,3,9b-tetrahydro-1,2-diphenyl-5H-pyrrolo*[2,1-a]*isoindol-5-one* (8) (1.4 g), which crystallised from benzene–light petroleum as white prisms, m.p. 165—168° (Found: C, 85.05; H, 5.9; N, 4.3. $C_{23}H_{19}NO$ requires C, 84.9; H, 5.9; N, 4.3%), ν_{CO} 1 692 cm^{-1}, δ 2.82 (1 H, t, *J* 11.0 Hz), 4.20 (5 H, m), and 5.10 (1 H, d, *J* 11.0 Hz) (aliphatic protons).

The aqueous mother liquor from which (6) and (8) were extracted was made slightly acidic with 6N-hydrochloric acid. The precipitate (5.5 g), which slowly solidified, was crystallised from methanol to give pure *o-(3,4-diphenylpyrrol-2-yl)benzoic acid* (7) as yellow-orange needles, m.p. 238—240° (decomp.), giving a positive Ehrlich reaction [8] (Found: C, 81.1; H, 4.95; N, 4.05. $C_{23}H_{17}NO_2$ requires C, 81.4; H, 5.05; N, 4.15%), ν_{NH} 3 367, ν_{CO} 1 681 cm^{-1}, $\lambda_{max.}$ 267 nm (log ε 4.08). The *methyl ester* (7a), obtained from (7) and diazomethane in ether, crystallised from methanol as orange plates, m.p. 164—166° (Found: C, 81.65; H, 5.45; N, 3.8. $C_{24}H_{19}NO_2$ requires C, 81.55; H, 5.4; N, 3.95%), ν_{NH} 3 356, ν_{CO} 1 695 cm^{-1}.

Photolysis of the Phthalimidines (4) and (5).—The mixture (4.0 g) in methanol (150 ml) was irradiated for 40 h at room temperature, with stirring, with a 70 W high-pressure mercury lamp (Hanau TQ81) equipped with an immersion well system. Evaporation afforded compound (6) (1.7 g).

N-(o-Benzoylphenethyl)phthalimide (9).—A solution of compound (6) (1.2 g) and *p*-nitroperbenzoic acid (2.0 g) in chloroform (60 ml) was kept at room temperature for 4 days. The precipitated *p*-nitrobenzoic acid was filtered off and the filtrate washed with 2N-sodium carbonate and evaporated. The residue crystallised from methanol as white *crystals*, m.p. 117—118° (Found: C, 77.7; H, 4.65; N, 3.95. $C_{23}H_{17}NO_3$ requires C, 77.8; H, 4.8; N, 3.95%), ν_{CO} 1 776, 1 698, and 1 664 cm^{-1}.

1,2-Diphenyl-5H-pyrrolo[2,1-a]*isoindol-5-one* (10).—The acid (7) (0.58 g) was heated for 15 min at 260 °C and the product, dissolved in benzene, was filtered through alumina. Evaporation of benzene and addition of light petroleum afforded yellow *needles* (0.4 g), m.p. 162—163° (Found:

[8] H. Fischer and H. Orth, ' Die Chemie des Pyrrols,' Academische Verlag, Weinheim, 1934, p. 66.

C, 85.7; H, 4.85; N, 4.35. $C_{23}H_{15}NO$ requires C, 85.95; H, 4.7; N, 4.35%), ν_{CO} 1 783, 1 751, and 1 773 cm^{-1}. The same product was obtained by refluxing (7) with acetic anhydride for 15 min and decomposing the excess of anhydride with water. Brief refluxing of (10) with ethanolic potassium hydroxide, gave, on acidification, the acid (7).

3-*Bromo*-1,2-*diphenyl*-5H-*pyrrolo*[2,1-a]*isoindol*-5-*one* (11). —(a) *From compound* (10). A stirred solution of the compound (0.2 g) in chloroform (10 ml) was treated with 1% (v/v) bromine in chloroform (5 ml). The residue obtained on evaporation at reduced pressure was crystallised from benzene–light petroleum to give the *bromo-derivative* (11) (0.2 g) as yellow-orange prisms, m.p. 229—231° (Found: C, 69.25; H, 3.4; N, 3.65. $C_{23}H_{14}BrNO$ requires C, 69.0; H, 3.55; N, 3.5%), ν_{CO} 1 748 cm^{-1}.

(b) *From compound* (8). A mixture of the compound (0.12 g), *N*-bromosuccinimide (0.12 g), and carbon tetrachloride (5 ml) was refluxed for 30 min. The solvent was removed at reduced pressure and the residue taken up in boiling methanol. The insoluble material (0.10 g) was the bromo-derivative (11).

3-*Methoxy*-1,2-*diphenyl*-5H-*pyrrolo*[2,1-a]*isoindol*-5-*one* (12).—To a stirred suspension of the finely ground pyrroloisoindolone (10) (1.0 g) in methanol (10 ml), bromine (0.2 ml) was added, and after 15 min the solvent was evaporated at reduced pressure. The residue (12) crystallised from methanol as red *needles*, m.p. 226—228° (Found: C, 82.1; H, 4.75; N, 4.1. $C_{24}H_{17}NO_2$ requires C, 82.05; H, 4.9; N, 4.0%), ν_{CO} 1 733 cm^{-1}, δ 3.86 (3 H, s).

3′,4′-*Diphenylspiro*[*phthalan*-1,2′-[3]*pyrroline*]-3,5′-*dione* (13).—(a) To a stirred solution of compound (7) (3.0 g) in methanol (100 ml), bromine (0.8 ml) in methanol (20 ml) was added slowly (30 min). The mixture was then diluted with water (500 ml); the precipitate (1.8 g) crystallised from methanol–water to give white *needles*, m.p. 251—252° (Found: C, 78.35; H, 4.25; N, 4.0. $C_{23}H_{15}NO_3$ requires C, 78.15; H, 4.3; N, 3.95%), ν_{NH} 3 226 and 3 125, ν_{CO} 1 776 and 1 706 cm^{-1}.

(b) Bromine (0.1 ml) was added to a suspension of (7) (0.35 g) in wet chloroform (60 ml) and the mixture was stirred at room temperature until a clear solution was obtained. The solvent was removed at reduced pressure and the residue, crystallised from benzene–light petroleum, afforded the spiran (13) (0.2 g).

(c) Compound (7) (0.2 g) was stirred at 90 °C with acetic acid (20 ml), 96% sulphuric acid (1.2 ml), and hydrogen peroxide (1.1 ml), until the initial dark red colour had faded almost completely (*ca.* 30 min). On pouring the solution into cold water (50 ml) a precipitate was formed, which crystallised from methanol–water to give the spiran (13) (0.15 g).

3,4-*Diphenylspiro*[*furan*-2(5H),1′-*phthalan*]-3′,5-*dione* (14).—Compound (13) (0.5 g) was refluxed for 20 h with 5N-sodium hydroxide (20 ml). The solution was then acidified with 6N-hydrochloric acid, boiled for 30 min, cooled, and extracted with ether. The extract on evaporation left a residue (0.2 g) which crystallised from methanol as white *needles*, m.p. 162—163° (Found: C, 77.75; H, 3.9. $C_{23}H_{14}O_4$ requires C, 77.95; H, 4.0%), ν_{CO} 1 789 cm^{-1}.

3,4-*Dihydro*-3,4-*diphenylspiro*[*furan*-2(5H),1′-*phthalan*]-3′,5-*dione* (15).—(a) *From compound* (14). Compound (14) (0.2 g), dissolved in acetic acid (20 ml), was hydrogenated at room temperature and pressure over platinum dioxide (50 mg). The mixture was diluted with water and extracted with ether; the extract was washed with a saturated solution of sodium hydrogen carbonate and evaporated. The oily residue was refluxed with 2N-sodium hydroxide for 30 min. The insoluble material was filtered off and the filtrate was acidified with 6N-hydrochloric acid, boiled for 10 min, cooled, and extracted with ether. The residue obtained on evaporation of the extract was crystallised from methanol to give the *product* (15) (90 mg) as white leaflets, m.p. 206—208° (Found: C, 77.4; H, 4.35. $C_{23}H_{16}O_4$ requires C, 77.5; H, 4.55%), ν_{CO} 1 792 cm^{-1}, δ 4.10, 4.31, 4.61, and 4.82 (2 H, ABq, H-3 and -4).

(b) *From* 2-*phenylindane*-1,3-*dione*. Potassium (0.4 g) was dissolved in t-butyl alcohol (10 ml) and to the solution were added 2-phenylindane-1,3-dione (2.2 g) and ethyl bromo(phenyl)acetate (2.4 g). The mixture was refluxed for 1 h, poured into water, and extracted with ether, the extract was evaporated at reduced pressure, and the residue was crystallised from methanol to afford *ethyl* 1,3-*dioxo*-2-*phenylindan*-2-*yl*(*phenyl*)*acetate* (16) (2.7 g) as white needles, m.p. 139—141° (Found: C, 77.95; H, 5.1. $C_{25}H_{20}O_4$ requires C, 78.1; H, 5.25%), ν_{CO} 1 739, 1 721, and 1 698 cm^{-1}.

The product (16) (1.0 g) was refluxed for 2 h with aqueous 25% potassium hydroxide. The resulting solution was acidified with 6N-hydrochloric acid, boiled for 10 min, and cooled; the precipitate crystallised from methanol to give (15) (0.5 g).

4-(β-*Hydroxyethoxy*)-3-*phenylisoquinolin*-1(2H)-*one* (18). —(a) (*Z*)-3-(α-Bromobenzylidene)phthalimidine (17) (2.0 g) was boiled under reflux for 20 min with potassium hydroxide (0.8 g) in ethylene glycol (8 ml). After cooling, water and acetic acid were added and the mixture was extracted with chloroform (2 × 20 ml). Evaporation of the combined extracts left a residue which crystallised from chloroform–benzene to give the *isoquinolone* (18) (1.1 g) as white leaflets, m.p. 190—191° (Found: C, 72.35; H, 5.45; N, 5.0. $C_{17}H_{15}NO_3$ requires C, 72.6; H, 5.35; N, 5.0%), ν_{CO} 1 634, ν_{OH} 3 448 cm^{-1}, δ 3.75 (4 H, s, $CH_2{\cdot}CH_2$).

(b) Refluxing compound (17) (2.0 g) with ethylene glycol (20 ml) containing sodium acetate (2.0 g) and the usual work-up gave (18) (0.7 g).

The *acetate* (19) (0.4 g) was obtained by refluxing (18) (0.5 g) with acetic acid (4 ml) containing concentrated hydrochloric acid (0.1 ml), dilution with water, and crystallisation of the precipitate from methanol, as light yellow needles, m.p. 207—209° (Found: C, 70.7; H, 5.25. $C_{19}H_{17}NO_4$ requires C, 70.55; H, 5.3%), ν_{CO} 1 730 and 1 645 cm^{-1}, δ 2.05 (3 H, s, Ac), and 3.80 and 4.20 (2 H each, m, $CH_2{\cdot}CH_2$).

4-[β-(β-*Hydroxyethoxy*)*ethoxy*]-3-*phenylisoquinolin*-1(2H)-*one* (20).—Treatment of compound (17) (2.0 g) with diethylene glycol–sodium acetate as described for the preparation of (18) [method (b)] afforded compound (20) (0.85 g), which crystallised from chloroform–benzene as white *prisms*, m.p. 114—115° (Found: C, 70.3; H, 5.7; N, 4.45. $C_{19}H_{19}NO_4$ requires C, 70.15; H, 5.9; N, 4.3%), ν_{CO} 1 642, ν_{OH} 3 448 cm^{-1}, δ 3.65 (8 H, m, 4 CH_2).

The *acetate* (21) (0.25 g) was prepared as described for (19) from (20) (0.35 g), and crystallised from ethanol as white leaflets, m.p. 118—120° (Found: C, 68.5; H, 5.85. $C_{21}H_{21}NO_5$ requires C, 68.65; H, 5.75%), ν_{CO} 1 739 and 1 645 cm^{-1}, δ 2.10 (3 H, s, Ac), 3.70 (6 H, m, 3 CH_2), and 4.22 (2 H, m, 1 CH_2).

(Z)-3-(α-*Methoxybenzylidene*)*phthalimidine* (22).—A solution of (17) (2.0 g) in methanol (50 ml) containing potassium hydroxide (2.0 g) was irradiated at room temperature for

15 h with a 70 W high-pressure lamp (Hanau TQ 81) equipped with an immersion well system (Pyrex glass). During the irradiation a constant stream of nitrogen was bubbled through the solution. Addition of an excess of 10% hydrochloric acid caused precipitation of an oil, which solidified on trituration with methanol. The product (0.6 g) crystallised from benzene–hexane as white *needles*, m.p. 177—179° (Found: C, 76.3; H, 5.35; N, 5.75. $C_{16}H_{13}NO_2$ requires C, 76.45; H, 5.2; N, 5.55%), ν_{CO} 1 692, ν_{OH} 3 165 cm^{-1}, δ 3.55 (3 H, s, CH_3), 6.67 (1 H, m, H-4), 7.27 (2 H, m, H-5 and -6), 7.50 (5 H, m, Ph), and 7.87 (1 H, m, H-7).

4-Hydroxy-3-phenylisoquinolin-1(2H)-one (23).—Compound (18) (0.5 g) was refluxed for 45 min with 57% hydroiodic acid (7.5 ml). Precipitation of (23) (0.35 g) was completed by diluting with water. The product, recrystallised from methanol–water, was identical (m.p. and i.r.) with an authentic sample.[4]

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