207. *A Reaction of Certain Diazosulphonates derived from β-Naphthol-1-sulphonic Acid. Part XVIII.* 1 : 4-*Diketo*-3-(*aminoaryl*)*tetrahydrophthalazines and Related Compounds.*

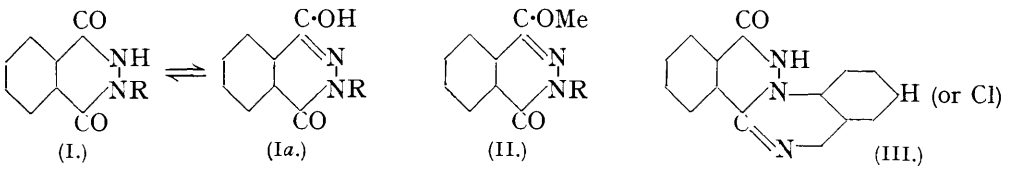
By F. M. Rowe, M. A. Lécutier, and A. T. Peters.

The methods by which 1 : 4-diketo-3-(nitroaryl)tetrahydrophthalazines (I; R = nitroaryl) and 4-keto-1-methoxy-3-(nitroaryl)-3 : 4-dihydrophthalazines (II; R = nitroaryl) have been obtained are reviewed. Two of the latter compounds have been prepared by a new method. *o*-, *m*-, and *p*-Nitro-compounds of each type have been reduced to the corresponding amino-compounds, all of which are diazotisable. The *o*-amino-compounds have been converted into 2′ : 4-anhydro-derivatives (III) by heating with dilute hydrochloric acid in a sealed tube at 180°, demethylation also occurring in the case of the 1-methoxy-compounds.

Only three 1 : 4-diketo-3-(nitroaryl)tetrahydrophthalazines, *viz.*, the 4′-nitrophenyl (Rowe and Levin, J., 1928, 2554), 3′-nitrophenyl (Rowe, Himmat, and Levin, *ibid.*, p. 2563), and 4′-nitro-2′-methylphenyl (Rowe and Siddle, J., 1932, 480) compounds, are obtainable from the corresponding nitro-3-arylphthalaz-1-ones *via* the alcohol compounds of their methylated products, followed by demethylation. The synthetic method, using a nitroarylhydrazine and phthalic anhydride, also has limitations, since, of the eight cases examined, only phthalyl-3′-nitro-, -4′-nitro-, and -4′-nitro-2′-methyl-phenylhydrazides are satisfactorily convertible into the corresponding 1 : 4-diketo-3-(nitroaryl)tetrahydrophthalazines. On the other hand, 1 : 4-diketo-3-(nitroaryl)tetrahydrophthalazines in general are prepared conveniently, and usually in good yields, by oxidising hot aqueous suspensions of 1-hydroxy-3-(nitroaryl)-3 : 4-dihydrophthalazine-4-acetic acids with potassium permanganate (Rowe, Gillan, and Peters, J., 1935, 1810): 1 : 4-*diketo*-3-(4′-*chloro*-2′-*nitrophenyl*)*tetrahydrophthalazine* and its analogues used in the present investigation have thus been prepared.

4-Keto-1-methoxy-3-(nitroaryl)-3 : 4-dihydrophthalazines, three of which are obtainable directly by the first method given above, are in general conveniently prepared by the methylation of 1 : 4-diketo-3-(nitroaryl)tetrahydrophthalazines; in addition, 4-keto-1-methoxy-3-(4′-nitrophenyl)-3 : 4-dihydrophthalazine is obtained by the action of nitrous acid, or of a boiling alcoholic solution of *p*-nitrosodimethylaniline, on 1-methoxy-3-(4′-nitrophenyl)-4-methylene-3 : 4-dihydrophthalazine and also as a by-product of the methylation of the latter compound in nitrobenzene solution with methyl sulphate (Rowe and Twitchett, J., 1936, 1709). We have now found that 4-keto-1-methoxy-3-(4′- and 3′-nitrophenyl)-3 : 4-dihydrophthalazines are prepared in good yield by oxidising hot aqueous solutions of 1-methoxy-3-(4′- and 3′-nitrophenyl)-4-methylphthalazinium perchlorates with potassium permanganate, the 4′-nitro-compound being obtained equally well by a similar oxidation of a solution of the methylene base in dilute sulphuric acid.

Oxidation of 1-hydroxy-3-(aminoaryl)-3 : 4-dihydrophthalazine-4-acetic acids with potassium permanganate having failed to give the 1 : 4-diketo-3-(aminoaryl)tetrahydrophthalazines, the amino-compounds now described were prepared by reduction of the corresponding nitro-compounds.



(I.) (Ia.) (II.) (III.)

4-*Keto*-1-*methoxy*-3-(4′-*aminophenyl*)-3 : 4-*dihydrophthalazine* (II; R = 4′-aminophenyl) is best prepared by reducing an alkaline solution of the corresponding nitro-compound with hyposulphite (hydrosulphite). The 3′-*amino*-compound cannot be obtained in this way owing to the insolubility of the nitro-compound in alkali, but reduction with acid stannous

chloride is satisfactory in this case and also for the 2′-*amino*-isomeride. On the other hand, 4-*keto*-1-*methoxy*-3-(4′-*chloro*-2′-*nitrophenyl*)-3 : 4-*dihydrophthalazine* is most effectively reduced to the 4′-*chloro*-2′-*amino*-compound by iron and dilute acetic acid. Although the amino-group cannot be eliminated from 4′-amino-3-phenylphthalaz-1-one without further degradation (Rowe and Levin, J., 1928, 2550), 4-keto-1-methoxy-3-phenyl-3 : 4-dihydrophthalazine (Rowe, Gillan, and Peters, J., 1935, 1815) is obtained from 4-keto-1-methoxy-3-(4′-aminophenyl)-3 : 4-dihydrophthalazine by diazotisation and treatment with sodium stannite.

1 : 4-Diketo-3-(aminoaryl)tetrahydrophthalazines (I; R = aminoaryl), like their nitro-analogues (Rowe, Gillan, and Peters, *loc. cit.*, p. 1809), appear to react only in the tautomeric form of 4-keto-1-hydroxy-3-(aminoaryl)-3 : 4-dihydrophthalazines (I*a*), but the nomenclature of (I) is retained in the present communication to avoid confusion with previous papers in this series. 1 : 4-*Diketo*-3-(4′- and 3′-*aminophenyl*)*tetrahydrophthalazines* are prepared by reducing the corresponding nitro-compounds with alkaline hyposulphite, as well as by demethylating the above ketomethoxy-compounds, but the high-melting 2′-*amino*- and 4′-*chloro*-2′-*amino*-analogues are best obtained by reducing the corresponding nitro-compounds with acid stannous chloride. Curiously enough, 1 : 4-diketo-3-(2′-amino- and 4′-chloro-2′-amino-phenyl)tetrahydrophthalazines form only *diacetyl* derivatives, whereas all the other amino-compounds now described form only *monoacetyl* derivatives.

2′-Amino-3-aryl- and 2′-amino-3-aryl-1-methyl-phthalaz-4-ones are converted into 2′ : 4-anhydro-derivatives by heating with dilute hydrochloric acid (1 : 8) in a sealed tube at 180° for 6 hours (Rowe, Adams, and Peters, J., 1937, 90). Under similar conditions, 2′ : 4-*anhydro*-1 : 4-*diketo*-3-(2′-*amino*- and 4′-*chloro*-2′-*amino*-*phenyl*)*tetrahydrophthalazines* (III) have now been obtained from the respective diketo-amino-compounds, as well as from the corresponding keto-methoxy-compounds owing to simultaneous demethylation and removal of 1 molecule of water. Compounds (III) form *acetyl* derivatives which appear to be acetoxy-compounds.

As has been observed with a number of other phthalazine derivatives, some of the amino-compounds now described retain solvent of crystallisation tenaciously and this cannot always be removed without degradation occurring.

Experimental.

4-Keto-1-methoxy-3-(4′-nitrophenyl)-3 : 4-dihydrophthalazine (J., 1928, 2554; 1935, 1811) was prepared by a new method. Finely powdered potassium permanganate (10 g.) was added to a solution of (*a*) 1-methoxy-3-(4′-nitrophenyl)-4-methylene-3 : 4-dihydrophthalazine (J., 1931, 1071) (5 g.) in concentrated sulphuric acid (70 c.c.) and water (500 c.c.), or (*b*) 1-methoxy-3-(4′-nitrophenyl)-4-methylphthalazinium perchlorate (J., 1936, 1709) (5 g.) in water (600 c.c.), at 90°; decolorisation occurred in 5 minutes. The mixture was then cooled, and sulphur dioxide introduced. When only an almost colourless precipitate remained, it was collected and crystallised from glacial acetic acid, forming colourless needles, m. p. and mixed m. p. with specimens prepared in other ways (*loc. cit.*) 199° [yield: (*a*) 4 g., 79·5%; (*b*) 3 g., 79·9%].

4-*Keto*-1-*methoxy*-3-(4′-*aminophenyl*)-3 : 4-*dihydrophthalazine* (II; R = 4′-aminophenyl).—Sodium hyposulphite (hydrosulphite) (5 g.) and water (100 c.c.) were added gradually to a boiling solution of 4-keto-1-methoxy-3-(4′-nitrophenyl)-3 : 4-dihydrophthalazine (1 g.) in water (40 c.c.), alcohol (120 c.c.), and sodium hydroxide (5 g.). When the deep brownish-red colour of the solution had changed to pale yellow (alkaline), the mixture was concentrated (125 c.c.) and cooled, and the precipitate collected. 4-*Keto*-1-*methoxy*-3-(4′-*aminophenyl*)-3 : 4-*dihydrophthalazine* crystallised from aqueous alcohol in colourless rectangular plates, m. p. 197° (yield, 0·8 g.; 89%) (Found: C, 67·2; H, 5·3; N, 15·5. $C_{15}H_{13}O_2N_3$ requires C, 67·4; H, 4·9; N, 15·7%), readily soluble in cold chloroform or hot benzene, but insoluble in ether or light petroleum. It was insoluble in aqueous alkalis, but readily soluble in warm dilute mineral acids, and was diazotisable. The *acetyl* derivative crystallised from water in colourless needles, m. p. 215—216° (Found: C, 66·0; H, 5·2; N, 13·7. $C_{17}H_{15}O_3N_3$ requires C, 66·0; H, 4·9; N, 13·6%).

Elimination of the Amino-group from 4-*Keto*-1-*methoxy*-3-(4′-*aminophenyl*)-3 : 4-*dihydrophthalazine*.—A solution of the amino-compound (1 g.) in dilute hydrochloric acid (50 c.c.;

1 : 8) at 5° was diazotised with sodium nitrite (0·5 g.), cooled to 0°, and a solution of sodium stannite (20 c.c.) [prepared by adding 50% aqueous sodium hydroxide to a solution of stannous chloride (1 part) in water (3 parts) until the precipitate had almost redissolved and then filtering] added. The precipitate of 4-keto-1-methoxy-3-phenyl-3 : 4-dihydrophthalazine crystallised from methyl alcohol in colourless needles, m. p. and mixed m. p. with the specimens already described (J., 1935, 1815) 111° (yield, 0·35 g.; 37·1%).

1 : 4-*Diketo*-3-(4′-*aminophenyl*)*tetrahydrophthalazine* (I; R = 4′-aminophenyl).—(*a*) Sodium hyposulphite (hydrosulphite) (3 g.) was added gradually to a solution of 1 : 4-diketo-3-(4′-nitrophenyl)tetrahydrophthalazine (J., 1935, 1811) (1 g.) in water (50 c.c.) and sodium hydroxide (1 g.) at 80° until the red colour of the solution had changed to pale yellow (alkaline). It was then concentrated (20 c.c.) and cooled, and hydrochloric acid added carefully until a white precipitate had separated completely (yield, 0·6 g.; 62·7%). (*b*) 4-Keto-1-methoxy-3-(4′-aminophenyl)-3 : 4-dihydrophthalazine (1 g.) was heated with hydrobromic acid (*d* 1·7; 12 c.c.) and glacial acetic acid (0·5 c.c.) in a sealed tube at 160—170° for 1 hour. The product was made alkaline with aqueous sodium hydroxide and filtered, and the cold filtrate precipitated carefully with hydrochloric acid (yield, 0·6 g.; 59·1%).

1 : 4-*Diketo*-3-(4′-*aminophenyl*)*tetrahydrophthalazine* crystallised from water in small colourless needles, m. p. 247—248°, containing 1 mol. of water (Found in material dried at 90° : C, 61·8; H, 4·9; N, 15·7. $C_{14}H_{11}O_2N_3,H_2O$ requires C, 62·0; H, 4·8; N, 15·5%) which was not removed completely by heat; recrystallisation from organic solvents did not give the anhydrous compound. The base is readily soluble in alcohols, pyridine, and nitrobenzene, but almost insoluble in acetone, benzene, chloroform, or ethyl acetate. It dissolves in cold aqueous alkalis and in warm dilute mineral acids, and is diazotisable. Attempts to prepare it by oxidising 1-hydroxy-3-(4′-aminophenyl)-3 : 4-dihydrophthalazine-4-acetic acid (10·5 g.) with potassium permanganate in a similar manner to that employed with the nitro-acid (*loc. cit.*) gave only 4′-amino-3-phenyl-4-methylphthalaz-1-one (yield, 3 g.; 33·8%) (J., 1931, 1072), together with intractable brown oxidation products. The N-*acetyl* derivative, prepared by boiling the base with glacial acetic acid and acetic anhydride (6 : 1) for 5 minutes, crystallised from water in colourless needles, m. p. 299—300° (Found : C, 65·1; H, 4·5; N, 14·2. $C_{16}H_{13}O_3N_3$ requires C, 65·1; H, 4·4; N, 14·2%), soluble in warm dilute mineral acids and in warm aqueous alkalis. All attempts to prepare a diacetyl derivative from the base or from this monoacetyl compound failed.

4-Keto-1-methoxy-3-(3′-nitrophenyl)-3 : 4-dihydrophthalazine (J., 1928, 2562; 1935, 1812) was prepared by oxidising 1-methoxy-3-(3′-nitrophenyl)-4-methylphthalazinium perchlorate (J., 1936, 1709) (5 g.) with potassium permanganate as described above for the 4′-nitro-isomeride [method (*b*) : yield, 3 g.; 79·9%].

4-*Keto*-1-*methoxy*-3-(3′-*aminophenyl*)-3 : 4-*dihydrophthalazine* (II; R = 3′-aminophenyl).—4-Keto-1-methoxy-3-(3′-nitrophenyl)-3 : 4-dihydrophthalazine (1·7 g.) was refluxed with stannous chloride (30 g.) in concentrated hydrochloric acid (75 c.c.) for 10 minutes. On cooling, the colourless crystalline hydrochloride, m. p. 251—254°, which separated almost quantitatively, was filtered off, washed with cold concentrated hydrochloric acid, and dissolved in water (350 c.c.) at 50°, and the base precipitated by ammonia. 4-*Keto*-1-*methoxy*-3-(3′-*aminophenyl*)-3 : 4-*dihydrophthalazine* crystallised from water or pyridine in colourless needles, m. p. 181° (yield, 1·4 g.; 91·6%) (Found : C, 67·6; H, 5·1; N, 15·85. $C_{15}H_{13}O_2N_3$ requires C, 67·4; H, 4·9; N, 15·7%), soluble in alcohols, acetone, and benzene. It is insoluble in aqueous alkalis, but soluble in warm dilute mineral acids, and is diazotisable. Reduction of the above nitro-compound in alkaline media was unsuccessful owing to its insolubility under these conditions, whereas the 4′-nitro-isomeride is best reduced in alkaline solution (see above). The *acetyl* derivative crystallised from aqueous alcohol in colourless prisms, m. p. 246—247° (Found : C, 65·8; H, 5·0; N, 13·4. $C_{17}H_{15}O_3N_3$ requires C, 66·0; H, 4·9; N, 13·6%).

1 : 4-*Diketo*-3-(3′-*aminophenyl*)*tetrahydrophthalazine* (I; R = 3′-aminophenyl).—(*a*) 1 : 4-Diketo-3-(3′-nitrophenyl)tetrahydrophthalazine (J., 1928, 2563; 1935, 1812) (1 g.) was reduced with alkaline hyposulphite (hydrosulphite) as described above for the 4′-nitro-isomeride (yield, 0·8 g.; 89·5%). (*b*) Iron powder (6 g.) and boiling water (50 c.c.) were added gradually and simultaneously to a boiling solution of 1 : 4-diketo-3-(3′-nitrophenyl)tetrahydrophthalazine (3 g.) in glacial acetic acid (150 c.c.) and water (50 c.c.). After boiling for a further 10 minutes (charcoal), the liquid was filtered; the base crystallised on cooling (yield, 1·9 g.; 70·9%). (*c*) 4-Keto-1-methoxy-3-(3′-aminophenyl)-3 : 4-dihydrophthalazine (1 g.) was demethylated by heating with hydrobromic acid (*d* 1·7; 5 c.c.) in a sealed tube at 150° for 1 hour, and the product precipitated by neutralising the solution with aqueous sodium hydroxide (yield, 0·7 g.; 73·9%).

1 : 4-*Diketo*-3-(3′-*aminophenyl*)*tetrahydrophthalazine* crystallised from water in almost colourless, irregular prisms, or from methyl alcohol in prismatic needles, m. p. 233—234° (Found : C, 66·2; H, 4·7; N, 17·0. $C_{14}H_{11}O_2N_3$ requires C, 66·4; H, 4·35; N, 16·6%), which were coloured brown by exposure to light. It dissolved in cold aqueous alkalis and in warm dilute mineral acids, and was diazotisable. The N-*acetyl* derivative crystallised from aqueous alcohol in small colourless needles, m. p. 153—154°, containing 1 mol. of water (Found in material dried at 90° : C, 61·1; H, 4·5; N, 13·0. $C_{16}H_{13}O_3N_3,H_2O$ requires C, 61·35; H, 4·8; N, 13·4%), which was not removed completely by heat or by crystallisation from other solvents.

4-*Keto*-1-*methoxy*-3-(2′-*aminophenyl*)-3 : 4-*dihydrophthalazine* (II; R = 2′-aminophenyl).—Finely powdered 4-keto-1-methoxy-3-(2′-nitrophenyl)-3 : 4-dihydrophthalazine (J., 1935, 1812) (2·5 g.) was ground with a solution of stannous chloride (10 g.) in concentrated hydrochloric acid (40 c.c.), and the mixture boiled for 10 minutes. After cooling, the colourless crystals were collected, dissolved in water (200 c.c.) and concentrated hydrochloric acid (5 c.c.) at 80°, and filtered, and the cold filtrate precipitated with ammonia. 4-*Keto*-1-*methoxy*-3-(2′-*aminophenyl*)-3 : 4-*dihydrophthalazine* crystallised from pyridine in colourless prisms, m. p. 234—235° (yield, 1·6 g.; 71·2%) (Found : C, 67·8; H, 5·1; N, 15·9. $C_{15}H_{13}O_2N_3$ requires C, 67·4; H, 4·9; N, 15·7%), insoluble in aqueous alkalis, but soluble in warm dilute mineral acids, and diazotisable. The *acetyl* derivative crystallised from alcohol in colourless needles, m. p. 219—220° (Found : C, 65·6; H, 4·9; N, 13·7. $C_{17}H_{15}O_3N_3$ requires C, 66·0; H, 4·9; N, 13·6%).

1 : 4-*Diketo*-3-(2′-*aminophenyl*)*tetrahydrophthalazine* (I; R = 2′-aminophenyl).—1 : 4-Diketo-3-(2′-nitrophenyl)tetrahydrophthalazine (J., 1935, 1812) (2 g.) was ground with a solution of stannous chloride (10 g.) in concentrated hydrochloric acid (50 c.c.), and the mixture boiled for 5 minutes; there was a transient solution and then crystals separated quickly. The liquid was filtered immediately, as further heating led to formation of some of the anhydro-compound (see below). The crystals were washed with warm concentrated hydrochloric acid, dissolved in dilute hydrochloric acid (200 c.c.; 1 : 20) at 80°, and filtered, and the cold filtrate neutralised carefully with ammonia. The almost colourless, amorphous precipitate which separated gradually was collected and dried in air. 1 : 4-*Diketo*-3-(2′-*aminophenyl*)*tetrahydrophthalazine*, after several crystallisations from pyridine, formed almost colourless prisms, darkening at 400°, followed by much shrinking and melting at 430° (approx.) (decomp.); they contained 1 mol. of pyridine (yield, 0·5 g.; 21·3%) (Found in material dried at air temperature : C, 68·6; H, 4·95; N, 16·4. $C_{14}H_{11}O_2N_3,C_5H_5N$ requires C, 68·7; H, 4·8; N, 16·9%), which was slowly lost on keeping. On heating at 130—140° for 2—3 hours, the transparent crystals gradually lost pyridine and became amorphous (Found : C, 66·7; H, 4·25; N, 16·6. $C_{14}H_{11}O_2N_3$ requires C, 66·4; H, 4·35; N, 16·6%). The compound dissolved in warm aqueous alkalis and in warm dilute mineral acids, and was diazotisable. The *diacetyl* derivative, obtained with acetic anhydride, crystallised from acetic anhydride in colourless prismatic needles, m. p. 224—225° (yield, 0·2 g. from 0·3 g. of the pyridine compound; 65·7%) (Found : C, 64·1; H, 4·6; N, 12·4. $C_{18}H_{15}O_4N_3$ requires C, 64·1; H, 4·45; N, 12·5%), insoluble in warm aqueous alkalis, but soluble on boiling.

2′ : 4-*Anhydro*-1 : 4-*diketo*-3-(2′-*aminophenyl*)*tetrahydrophthalazine* (III).—1 : 4-Diketo-3-(2′-aminophenyl)tetrahydrophthalazine (0·8 g. of the pyridine compound) was heated with dilute hydrochloric acid (18 c.c.; 1 : 8) in a sealed tube at 180° for 6 hours. The crystals were collected, ground with a little warm aqueous ammonia, and washed. 2′ : 4-*Anhydro*-1 : 4-*diketo*-3-(2′-*aminophenyl*)*tetrahydrophthalazine* crystallised from pyridine in almost colourless prisms, m. p. > 430° (decomp.) (yield, 0·4 g.; 70·6%) (Found : C, 71·7; H, 3·8; N, 17·7. $C_{14}H_9ON_3$ requires C, 71·5; H, 3·8; N, 17·9%), less soluble in pyridine than the amino-compound from which it is derived. It is soluble in warm aqueous alkalis and in hot dilute mineral acids. It was also obtained by heating 4-keto-1-methoxy-3-(2′-aminophenyl)-3 : 4-dihydrophthalazine (2 g.) with dilute hydrochloric acid (25 c.c.; 1 : 8) in a sealed tube at 180° for 6 hours (yield, 1·1 g.; 62·5%) (Found : N, 17·9%) [confirmed by conversion into the acetyl derivative (below), m. p. and mixed m. p. 222—223°]. The O-*acetyl* derivative crystallised from acetic anhydride in colourless needles, m. p. 222—223° (mixed with the above diacetyl derivative of the 2′-amino-compound, it melted at 202°) (Found : C, 69·0; H, 3·9; N, 15·3. $C_{16}H_{11}O_2N_3$ requires C, 69·3; H, 4·0; N, 15·2%), insoluble in aqueous alkalis.

1 : 4-*Diketo*-3-(4′-*chloro*-2′-*nitrophenyl*)*tetrahydrophthalazine*, obtained by the oxidation of 1-hydroxy-3-(4′-chloro-2′-nitrophenyl)-3 : 4-dihydrophthalazine-4-acetic acid (J., 1935, 1803) (10 g.) with potassium permanganate in a similar manner to that employed with the 2′-nitro-analogue (J., 1935, 1812), crystallised from glacial acetic acid in yellow prismatic needles, m. p. 286—287° (yield, 4 g.; 45·5%) (Found : C, 52·95; H, 2·6; Cl, 11·3. $C_{14}H_8O_4N_3Cl$ requires

C, 52·9; H, 2·5; Cl, 11·2%), soluble in dilute sodium carbonate solution with a yellow colour, and in aqueous sodium hydroxide or ammonia with an orange-yellow colour.

4-*Keto*-1-*methoxy*-3-(4′-*chloro*-2′-*nitrophenyl*)-3 : 4-*dihydrophthalazine*, prepared *via* the yellow silver salt (2 g.) of the above diketo-compound by refluxing with methyl iodide in dry benzene, crystallised from benzene in pale yellow, prismatic needles, m. p. 225—228° (yield, 1·1 g.; 70·5%) (Found : C, 54·2; H, 3·1; Cl, 10·6. $C_{15}H_{10}O_4N_3Cl$ requires C, 54·3; H, 3·0; Cl, 10·7%).

4-*Keto*-1-*methoxy*-3-(4′-*chloro*-2′-*aminophenyl*)-3 : 4-*dihydrophthalazine* (II; R = 4′-chloro-2′-aminophenyl).—Iron powder (3 g.) was added gradually during 10 minutes to a boiling solution of 4-keto-1-methoxy-3-(4′-chloro-2′-nitrophenyl)-3 : 4-dihydrophthalazine (2 g.) in glacial acetic acid (50 c.c.) and water (30 c.c.). After boiling for a further 10 minutes (charcoal), the liquid was filtered, and boiling water (50 c.c.) added. 4-*Keto*-1-*methoxy*-3-(4′-*chloro*-2′-*aminophenyl*)-3 : 4-*dihydrophthalazine*, which separated on cooling, crystallised from benzene in colourless prisms, m. p. 217—219° (yield, 1 g.; 55%) (Found : C, 60·1; H, 4·0; N, 14·3; Cl, 11·5. $C_{15}H_{12}O_2N_3Cl$ requires C, 59·7; H, 4·0; N, 13·9; Cl, 11·8%), insoluble in aqueous alkalis, but soluble in hot dilute mineral acids, and diazotisable. The above nitro-compound was only partly reduced by prolonged boiling with stannous chloride and hydrochloric acid, in presence or absence of glacial acetic acid. The *acetyl* derivative crystallised from alcohol in colourless needles, m. p. 272—274° (Found : C, 59·0; H, 3·9; N, 11·9; Cl, 10·3. $C_{17}H_{14}O_3N_3Cl$ requires C, 59·4; H, 4·1; N, 12·2; Cl, 10·3%).

1 : 4-*Diketo*-3-(4′-*chloro*-2′-*aminophenyl*)*tetrahydrophthalazine* (I; R = 4′-chloro-2′-aminophenyl).—1 : 4-Diketo-3-(4′-chloro-2′-nitrophenyl)tetrahydrophthalazine (2 g.) was reduced with stannous chloride (12 g.) and concentrated hydrochloric acid (50 c.c.) by boiling for 10 minutes, and the product isolated as described above for the 2′-amino-analogue. 1 : 4-*Diketo*-3-(4′-*chloro*-2′-*aminophenyl*)*tetrahydrophthalazine* crystallised from pyridine in almost colourless needles, which began to shrink and darken at 440°, but did not melt (yield, 0·8 g.; 44·2%) (Found : C, 58·5; H, 3·5; N, 14·85; Cl, 12·3. $C_{14}H_{10}O_2N_3Cl$ requires C, 58·4; H, 3·5; N, 14·6; Cl, 12·35%), soluble in warm aqueous alkalis and in hot dilute mineral acids, and diazotisable. It was unaltered by warming with concentrated sulphuric acid at 100° for 5 minutes [confirmed by conversion into the diacetyl derivative (below), m. p. and mixed m. p. 245—246°]. The *diacetyl* derivative, obtained with acetic anhydride, crystallised from alcohol in fine colourless needles, m. p. 245—246° (yield, 0·4 g. from 0·4 g. of the base; 77·4%) (Found : C, 58·3; H, 3·9; N, 11·7; Cl, 9·3. $C_{18}H_{14}O_4N_3Cl$ requires C, 58·15; H, 3·8; N, 11·3; Cl, 9·55%), insoluble in aqueous alkalis.

2′: 4-*Anhydro*-1 : 4-*diketo*-3-(4′-*chloro*-2′-*aminophenyl*)*tetrahydrophthalazine* (III).—1 : 4-Diketo-3-(4′-chloro-2′-aminophenyl)tetrahydrophthalazine (2 g.) was heated with dilute hydrochloric acid (18 c.c.; 1 : 8) in a sealed tube at 170° for 6 hours, and the product isolated as described above for the analogous 2′-amino-derivative. The *anhydro*-compound (III) crystallised from pyridine in small colourless needles, which did not melt at 440° (yield, 1·2 g.; 64%) (Found : C, 62·3; H, 3·1; N, 15·3; Cl, 13·2. $C_{14}H_8ON_3Cl$ requires C, 62·3; H, 3·0; N, 15·6; Cl, 13·2%); it was soluble in warm aqueous alkalis and sparingly soluble in dilute mineral acids. It was also obtained by heating 4-keto-1-methoxy-3-(4′-chloro-2′-aminophenyl)-3 : 4-dihydrophthalazine (1·5 g.) with dilute hydrochloric acid (18 c.c.; 1 : 8) in a sealed tube at 180° for 6 hours (yield, 0·9 g.; 67·1%) (Found : C, 62·3; H, 3·0; N, 15·3; Cl, 13·2%). The O-*acetyl* derivative separated from a solution of the anhydro-compound in acetic anhydride and a little pyridine in fine colourless needles, which did not melt at 440° (Found : C, 61·3; H, 3·0; N, 13·1; Cl, 11·2. $C_{16}H_{10}O_2N_3Cl$ requires C, 61·6; H, 3·2; N, 13·5; Cl, 11·4%) and were insoluble in aqueous alkalis.

CLOTHWORKERS' RESEARCH LABORATORY, LEEDS UNIVERSITY. [*Received, May 24th,* 1938.]