404. *Quinoxaline* N-*Oxides. Part V.* Further* Bz-*Substituted Derivatives.*

By J. A. Silk.

Di-*N*-oxides of 6-hydroxy-, 6-ethoxycarbonyl-, and 6-acetyl-2 : 3-dimethylquinoxaline are described, together with nitro-, bromo-, and iodo-derivatives of the phenol, and functional derivatives of the other two. 5-Hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide possesses a novel type of chelating structure.

The preparation of the quinoxaline 1 : 4-dioxides now described formed a continuation of the study in these laboratories of compounds of this class as amœbicidal and antiviral agents.[1] 6-Hydroxy-, 6-ethoxycarbonyl-, and 6-acetyl-quinoxline and their 2 : 3-dimethyl homologues were prepared by condensing glyoxal or diacetyl with the appropriate *o*-phenylenediamine, and 5-hydroxy-2 : 3-dimethylquinoxaline was obtained by de-ethylation of the 5-ethoxy-compound with aluminium chloride. 2 : 3-Dimethylquinoxaline-6-carboxylic acid could not be esterified in the normal manner, since both hydrochloric and sulphuric acids caused formation of a green condensation product. This was soluble only in hot alkali with evolution of ammonia, and as the 6-acetyl analogue behaved similarly with strong acids, this reaction appears to be characteristic of 2 : 3-dimethylquinoxalines bearing a negative group in the 6-position.

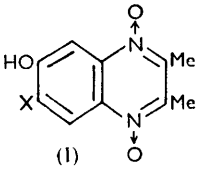
Variable results were obtained in the *N*-oxidation of some of the quinoxalines, and these are attributed mainly to variations, which were incompletely elucidated, in the quality of the peracetic acid. Best results were obtained with a reagent containing about 0·3% w/v of sulphuric acid and 0·1% of sodium pyrophosphate; neutralisation of this small quantity of sulphuric acid with sodium acetate [2] was unnecessary; and addition of more than the equivalent quantity was definitely harmful. A per-acid strength of 2M was generally preferred to 1·3M.

In accordance with earlier experiences of the effect of negative groups in the benzene ring (see Part I[2a]), oxidation of 6-acetyl- and 6-carbethoxy-quinoxaline did not give *N*-oxides, but gave low yields of high-melting solids which were not characterised, but may have been the 2 : 3-dihydroxy-compounds. Oxidation of the 2 : 3-dimethyl homologues and also of

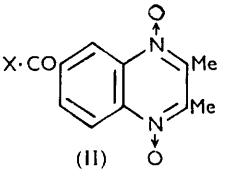
* Part IV, preceding paper.

[1] Hurst, Landquist, Melvin, Peters, Senior, Silk, and Stacey, *Brit. J. Pharmacol.*, 1953, **8**, 297.
[2] Findley, Swern, and Scanlan, *J. Amer. Chem. Soc.*, 1945, **67**, 412.
[2a] Landquist, *J.*, 1953, 2816.

6-hydroxy-2 : 3-dimethylquinoxaline gave 1 : 4-dioxides, although the yield of 6-ethoxycarbonyl-2 : 3-dimethylquinoxaline 1 : 4-dioxide was unaccountably variable. 6-Hydroxyquinoxaline 1 : 4-dioxide has been described as a hemihydrate by King, Clark, and Davis,[3] but in my experience a satisfactory product could seldom be obtained, and the state of hydration varied. A hydrated dioxide was also obtained in low yield by treating 6-methoxyquinoxaline 1 : 4-dioxide with aluminium chloride; hydrobromic acid attacked the ether



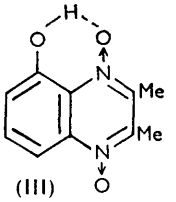
(I)



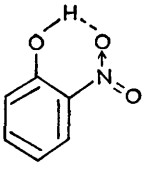
(II)

linkage only slowly and the product was not identified. Oxidation of 6-acetoxyquinoxaline failed to give a dioxide, although all the per-acid, which was present in 50% excess, was consumed. 6-Ethoxycarbonylmethoxyquinoxaline, which was formed from the reaction between 6-hydroxyquinoxaline and ethyl chloroacetate in presence of sodium ethoxide, gave a mixture of mono- and di-oxides, but owing to the low yield their separation was not pursued. 5-Hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (III) was prepared by treatment of the methoxy-dioxide with aluminium chloride in nitrobenzene at 60°; in boiling benzene the principal product was a mono-*N*-oxide, and in view of the similarity of its ultraviolet absorption spectrum to that of 5-methoxy-2 : 3-dimethylquinoxaline 1-oxide, it is regarded as the 5-hydroxy-1-oxide.

The hydroxyl group in the *Bz*-ring confers phenolic properties on the hydroxy-dioxides, and 5-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide gives a sparingly soluble orange-red sodium salt with dilute sodium hydroxide solution. The 6-isomer is slightly soluble, without effervescence, in sodium hydrogen carbonate solution. With ferric chloride the 5-hydroxy-dioxide gives a deep red-brown colour, and the 5-hydroxy-1-oxide a greenish brown, while the 6-hydroxy-dioxides show only slight darkening. 5-Hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide possesses a novel type of chelating structure which formally resembles an *o*-nitrophenol (IV), in contrast to the 8-hydroxyquinoline type of the parent



(III)



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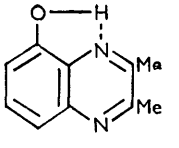

(V)

quinoxaline (V). The presence of hydrogen bonding is shown by the solubility in chloroform and benzene, in which the 6-isomer is practically insoluble, and by a melting point nearly 100° lower than that of the 6-isomer. The dioxide forms a greenish brown copper complex, and its ultraviolet absorption spectrum closely resembles that of the 5-methoxy-dioxide; in comparison with other quinoxaline dioxides it is very stable to light.

Nitro- and halogeno-derivatives were prepared from 6-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide, and substitution is presumed to take place at the 7- rather than 5-position which is likely to be sterically hindered. The nitro-derivative (I; X = NO_2) was best prepared with ice-cold mixed acid; with 30% aqueous nitric acid a crystalline nitrate of the starting material was isolated. Reaction with iodine–potassium iodide in sodium hydrogen carbonate solution took place during several days to give a monoiodo-compound (I; X = I) which tended to lose iodine on recrystallisation. Bromine under similar conditions reacted immediately, giving first a monobromo-derivative, which could be isolated by acidification, and then an insoluble, red dibromo-compound in which one bromine atom

[3] King, Clark, and Davis, *J.*, 1949, 3012.

was labile and was removed by treatment with sodium hydrogen sulphite or potassium iodide. Unlike other 6-hydroxyquinoxaline dioxides it was soluble in benzene, although it could not be recrystallised without partial loss of bromine. The first compound is undoubtedly the normal monosubstitution product, 7(?)-bromo-6-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide, while the second may be an addition compound of two molecules of this with one of bromine; the bromine addition compounds of some other quinoxaline dioxides (see Part IV), however, contain 1·5 atoms of bromine per molecule of dioxide.

6-Ethoxycarbonyl-2 : 3-dimethylquinoxaline 1 : 4-dioxide (II; X = OEt) was readily hydrolysed to the acid by cold alkali, suggesting activation of the carboxyl group by the *N*-oxide system. With ammonia and dimethylamine in the cold the ester gave the amide (II; X = NH_2) and the dimethylamide (II; X = NMe_2) respectively, while 3-piperidinopropylamine at 90° gave a basic amide (II; X = $NH{\cdot}[CH_2]_3{\cdot}NC_5H_{10}$). The hydroxamic acid (II; X = NH·OH) was also prepared. Transesterification with 2-diethylaminoethanol with or without sodium ethoxide could not be accomplished owing to decomposition, and oxidation of 2′-diethylaminoethyl 2 : 3-dimethylquinoxaline-6-carboxylate with peracetic or perphthalic acid was unsuccessful.

6-Hydroxymethyl-2 : 3-dimethylquinoxaline was formed in poor yield by reduction of the quinoxaline ester with lithium aluminium hydride.

Experimental

6-Hydroxyquinoxaline.—4-Amino-3-nitrophenol (15 g.; from hydrolysis of the *ON*-diacetyl derivative [4] with 6N-hydrochloric acid and neutralisation of the isolated hydrochloride) was hydrogenated in methanol (150 c.c.) with Raney nickel, the mixture being heated to dissolve the 3 : 4-diaminophenol before filtration from catalyst. The filtrate was concentrated *in vacuo* (to 75 c.c.) and mixed with a warm solution of sodium acetate (10 g.; anhydrous) and glyoxal–sodium bisulphite compound (28·5 g.) in water (140 c.c.). 6-Hydroxyquinoxaline (7 g.) was collected after heating at 60° for 2½ hr. and was recrystallised from water to give material of m. p. 252—254° (lit., 242°).

6-Hydroxy-2 : 3-dimethylquinoxaline.—4-Amino-3-nitrophenol (30·8 g.) was hydrogenated (as above) and the diamine solution heated for 3 hr. on a steam-bath with diacetyl (18 g.) and sodium acetate (50 g.; anhydrous) in water (300 c.c.). Recrystallisation of the product from water gave *6-hydroxy-2 : 3-dimethylquinoxaline* (22·6 g.), m. p. 247—249° (Found: N, 16·25. $C_{10}H_{10}ON_2$ requires N, 16·1%).

6-Ethoxycarbonylmethoxyquinoxaline.—6-Hydroxyquinoxaline (2·92 g.) was added to ethanol (20 c.c.) in which sodium (0·46 g.) had been dissolved, and followed by ethyl chloroacetate (3·0 g.). After being refluxed for 30 min., more sodium ethoxide solution (0·46 g. of sodium) and ethyl chloroacetate (3·0 g.) were added, and heating continued for another 2 hr. The cooled mixture was concentrated and poured into water. Extraction with benzene gave *6-ethoxycarbonylmethoxyquinoxaline* (0·9 g.), m. p. 99—100° (from water) (Found: N, 12·25. $C_{12}H_{12}O_3N_2$ requires N, 12·1%).

5-Hydroxy-2 : 3-dimethylquinoxaline.—Crushed aluminium chloride (5 g.) was added to 5-ethoxy-2 : 3-dimethylquinoxaline (5 g.) in benzene (125 c.c.); a tar separated, and the mixture was heated under reflux ($CaCl_2$ tube) for 16 hr. The tar was decomposed by stirring the cooled mixture with ice–water (100 g.), and benzene was evaporated in a current of air, since the benzene–water emulsion could not be broken. The solid *A* which separated, was collected. The filtrate was brought to pH 4 and extracted with benzene three times; the residue from these extracts was extracted with hot dilute sodium hydroxide solution (charcoal), which was then neutralised giving solid *B*. Recrystallisation of solids *A* and *B* together from water gave *5-hydroxy-2 : 3-dimethylquinoxaline* (0·89 g.), m. p. 146—147°, needles, soluble in dilute alkali and forming a yellow copper complex (Found: C, 68·9; H, 5·8; N, 15·5. $C_{10}H_{10}ON_2$ requires C, 68·95; H, 5·8; N, 16·1%).

Ethyl 3 : 4-Diaminobenzoate.—Ethyl 4-amino-3-nitrobenzoate, m. p. 140—142°, was obtained by heating 4-acetamido-3-nitrobenzoic acid with ethanol and sulphuric acid (3% v/v) for 24 hr. (yields, 70—75%) or with ethanolic hydrochloric acid for 5 hr. (yields, 80—85%). Hydrogenation with Raney nickel in methanol gave ethyl 3 : 4-diaminobenzoate, m. p. 112—114°, needles from dilute alcohol (80% yield).

Ethyl Quinoxaline-6-carboxylate.—A solution of glyoxal [from the sulphate (6·1 g.) in warm

[4] Fieser and Martin, *J. Amer. Chem. Soc.*, 1935, **57**, 1835.

water (40 c.c.) and barium carbonate] and ethyl 3 : 4-diaminobenzoate (4·5 g.) were stirred vigorously at 60° for 1 hr. Since some diamine remained, a similar portion of glyoxal was added and reaction was continued for another hour. Repeated crystallisation of the product from benzene–*cyclo*hexane (Al_2O_3) gave *ethyl quinoxaline-6-carboxylate* (2·3 g.), m. p. 68—70° (Found: N, 14·2. $C_{11}H_{10}O_2N_2$ requires N, 13·85%).

Oxidation of this quinoxaline with peracetic acid at ordinary temperature or at 50° gave a solid, m. p. *ca.* 340°, appreciably soluble only in 75% acetic acid.

Ethyl 2 : 3-*Dimethylquinoxaline-6-carboxylate*.—Ethyl 3 : 4-diaminobenzoate (42 g.) and diacetyl (22 g.) were refluxed for 30 min. in 33% ethanol (500 c.c.) (charcoal), and then cooled. *Ethyl* 2 : 3-*dimethylquinoxaline-6-carboxylate* (48 g.), m. p. 102—104°, crystallised in feathery needles (Found: N, 12·2. $C_{13}H_{14}O_2N_2$ requires N, 12·05%).

2′-*Diethylaminoethyl* 2 : 3-*Dimethylquinoxaline-6-carboxylate*.—Ethyl 2 : 3-dimethylquinoxaline-6-carboxylate (5 g.) and 2-diethylaminoethanol (15 g.) were refluxed for 16 hr., and the mixture then distilled *in vacuo*. After removal of excess of amino-alcohol, the basic ester distilled at approximately 200°/1 mm. and was purified by passage in benzene–light petroleum (b. p. 60—80°) through alumina. This gave 2′-*diethylaminoethyl* 2 : 3-*dimethylquinoxaline-6-carboxylate* (2·5 g.), m. p. 43—46° (Found: N, 14·2. $C_{17}H_{23}O_2N_3$ requires N, 13·95%).

6-*Acetylquinoxaline*.—4-Amino-3-nitroacetophenone [5] (4·5 g.) was hydrogenated at ordinary temperature and pressure in ethanol (100 c.c.) in presence of palladium–charcoal until the hydrogen uptake corresponded to that required for reduction of the nitro-group. The filtered solution was treated with the filtrate from neutralisation of glyoxal sulphate (6 g.) in water (100 c.c.) with barium carbonate, and the mixture heated and stirred at 60° for 1 hr. After the solution had been evaporated to dryness, the residue was crystallised from *cyclo*hexane (Al_2O_3), giving 6-*acetylquinoxaline* (1·47 g.), m. p. 106—108° (Found: N, 16·1. $C_{10}H_8ON_2$ requires N, 16·3%).

6-*Acetyl*-2 : 3-*dimethylquinoxaline*.—4-Amino-3-nitroacetophenone (5·4 g.) was hydrogenated as above and the solution of 3 : 4-diaminoacetophenone refluxed with diacetyl (2·9 g.) for 1 hr., giving 6-acetyl-2 : 3-dimethylquinoxaline (5·35 g.), m. p. 116—118°, after crystallisation from aqueous ethanol (lit., 117—119°) (Found: N, 14·15. Calc. for $C_{12}H_{12}ON_2$: N, 14·0%).

6-*Hydroxymethyl*-2 : 3-*dimethylquinoxaline*.—A solution of ethyl 2 : 3-dimethylquinoxaline-6-carboxylate (5 g.) in dry ether (100 c.c.) was added during 10 min. to a stirred solution of lithium aluminium hydride (0·28 g.) in dry ether (50 c.c.). After a further 10 min., ethyl acetate (2 c.c.) was added, followed by water (50 c.c.). The filtered mixture was separated, the aqueous phase extracted twice more, and the extracts washed with water and dried (Na_2SO_4). The residue from evaporation was extracted with hot benzene (Al_2O_3), which on concentration gave the *quinoxaline* (0·7 g.), m. p. 113—114° (Found: C, 70·6; H, 6·6; N, 15·3. $C_{11}H_{12}ON_2$ requires C, 70·3; H, 6·4; N, 14·9%).

6-*Hydroxyquinoxaline* 1 : 4-*Dioxide*.—6-Methoxyquinoxaline 1 : 4-dioxide (1 g.) and aluminium chloride (2 g.) were refluxed ($CaCl_2$ tube) in benzene (25 c.c.) for 17 hr. The cooled mixture was stirred with ice–water (25 g.) and filtered, and the solid recrystallised repeatedly from water to give yellow needles, m. p. 247—250° (decomp.) (Found, after being dried at 100°: C, 52·3; H, 3·8; N, 15·1. Calc. for $3C_8H_6O_3N_2,H_2O$: C, 52·2; H, 3·6; N, 15·2%).

6-*Hydroxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—6-Hydroxy-2 : 3-dimethylquinoxaline (5 g.) was oxidised with 1M-peracetic acid (75 c.c.) at 60° for 17 hr. The solution was evaporated under reduced pressure, the residue treated with water, and the solid recrystallised from water to give 6-*hydroxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*dioxide* (3·0 g.), m. p. 249—250° (decomp.), fine yellow needles (Found: C, 58·6; H, 5·15; N, 13·75. $C_{10}H_{10}O_3N_2$ requires C, 58·3; H, 4·9; N, 13·6%).

5-*Hydroxy*-2 : 3-*dimethylquinoxaline* 1-*Oxide*.—5-Methoxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (2·33 g.) and aluminium chloride (7 g.) were refluxed with stirring in benzene (50 c.c.) for 17 hr. Benzene was decanted off and the tar stirred with ice–water and concentrated hydrochloric acid (10 c.c.). The solid was ground with 2N-sodium hydroxide, and the solution was filtered and acidified to give 5-*hydroxy*-2 : 3-*dimethylquinoxaline* 1-*oxide*, cream needles, m. p. 143—144·5° (from benzene–*cyclo*hexane) (Found: C, 63·0; H, 5·25; N, 15·05. $C_{10}H_{10}O_2N_2$ requires C, 63·15; H, 5·25; N, 14·75%).

5-*Hydroxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—The methoxy-dioxide (2·2 g.), aluminium chloride (3·5 g.), and nitrobenzene (50 c.c.) were stirred at 60—65° for 16 hr., and then cooled and treated with ice–water (50 c.c.) and 10N-sodium hydroxide (10 c.c.). The sparingly soluble sodium salt was decomposed with dilute acetic acid, giving 5-*hydroxy*-2 : 3-*dimethylquinoxaline*

[5] Mayer, Stark, and Schön, *Ber.*, 1932, **65**, 1334.

1 : 4-*dioxide* (1·08 g.) which after crystallisation from benzene had m. p. 171—173° (Found: C, 58·2; H, 4·75; N, 13·1. $C_{10}H_{10}O_3N_2$ requires C, 58·3; H, 4·9; N, 13·6%). A further small quantity (50 mg.; m. p. 166—168°) was obtained by evaporation of the nitrobenzene under reduced pressure, and acidification of the aqueous phase gave a small quantity of mono-*N*-oxide. The hydroxy-dioxide formed a greenish-brown copper derivative when a chloroform solution was shaken with aqueous cuprammonium sulphate.

6-*Hydroxy*-2 : 3-*dimethyl*-7(?)-*nitroquinoxaline* 1 : 4-*Dioxide*.—6-Hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (0·2 g.) was dissolved in a mixture of nitric acid (0·5 c.c.; *d* 1·4) and concentrated sulphuric acid (0·5 c.c.) at 0°, and stored in ice for 1½ hr. The product obtained by pouring the mixture into a large quantity of water was recrystallised from 50% aqueous alcohol, giving the *nitro-derivative*, m. p. 258° (decomp.), mixed m. p. with starting material 243° (decomp.) (Found: N, 16·9. $C_{10}H_9O_5N_3$ requires N, 16·7%). On a larger scale the starting material was added to the acid in portions, and the product crystallised from 50% aqueous acetic acid.

With nitric acid–water (1 : 1) 6-hydroxy-2 : 3-dimethylquinoxaline 1: 4-dioxide nitrate, m. p. 97° (decomp.), crystallised.

6-*Hydroxy*-7(?)-*iodo*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—Solutions of 6-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (1·42 g.) in saturated sodium hydrogen carbonate (50 c.c.) and iodine (5·25 g.) in 10% potassium iodide (70 c.c.) were mixed and the solution kept for 10 days at laboratory temperature and then filtered. Sulphur dioxide was bubbled through the solution, and the yellow precipitate washed well with water. The yield of *iodo-derivative*, m. p. 148—150°, was 1·3 g. (Found: N, 8·2; I, 34·8. $C_{10}H_9O_3N_2I$ requires N, 8·4; I, 38·2%). The compound could not be crystallised without partial loss of iodine.

7(?)-*Bromo*-6-*hydroxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—A solution of bromine (1·5 g.) in 12·5% potassium bromide (12 c.c.) was run into one of 6-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (1·5 g.) in saturated sodium hydrogen carbonate until the red dibromo-compound began to separate. The solution was filtered and acidified with dilute sulphuric acid. The *monobromo-derivative* (1·8 g.) crystallised from water in golden needles, m. p. 180° (decomp.) (Found: C, 42·4; H, 3·3; Br, 27·9. $C_{10}H_9O_3N_2Br$ requires C, 42·15; H, 3·2; Br, 28·05%).

Dibromo-6-*hydroxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—A solution of bromine (3·7 g.) in 15% potassium bromide (30 c.c.) was added during 15 min. to one of 6-hydroxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (2·06 g.) in saturated sodium hydrogen carbonate (100 c.c.), and the dark red *dibromo-derivative* (1·26 g.), m. p. 138° (explodes), collected after a further 15 min., washed with water, and dried ($CaCl_2$) at ordinary pressure (Found: C, 33·05; H, 2·15; Br, 41·1. $C_{10}H_8O_3N_2Br_2$ requires C, 33·0; H, 2·2; Br, 43·9%).

6-*Carbethoxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—The quinoxaline (9 g.) and 1·7M-peracetic acid (70 c.c., containing 0·3% w/v of sulphuric acid and 0·1% of sodium pyrophosphate) were kept for 7 hr. at ordinary temperature and then at 55° for 9 hr. Most of the acetic acid was evaporated under reduced pressure, and the residue was treated with saturated sodium hydrogen carbonate solution. The solid (9·0 g.) slowly obtained was crystallised from benzene–*cyclo*hexane, giving 6-*carbethoxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*dioxide* (4·5 g.), m. p. 134—135° (Found: C, 59·6; H, 5·5; N, 10·9. $C_{13}H_{14}O_4N_2$ requires C, 59·5; H, 5·4; N, 10·7%). Yields by this method were 37—50% and with peracetic acid containing 0—1% of sulphuric acid but no pyrophosphate they were 0—50%. Performic acid and hydrogen peroxide in acetone or acetic acid were unsatisfactory.

6-*Carboxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—Sodium hydroxide solution (2 c.c.; 10N) was added to 6-carbethoxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (2·3 g.) suspended in water (10 c.c.); after 30 min. at room temperature the solution was acidified with 5N-hydrochloric acid (5 c.c.), and the precipitate crystallised from 2-ethoxyethanol, giving 6-*carboxy*-2 : 3-*dimethylquinoxaline* 1 : 4-*dioxide* (1·15 g.), m. p. 243° (decomp.) (Found: C, 56·45; H, 4·45; N, 12·4. $C_{11}H_{10}O_4N_2$ requires C, 56·45; H, 4·3; N, 11·95%).

6-*Carbamoyl*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—6-Carbethoxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (2 g.) and saturated methanolic ammonia (20 c.c.) were kept at room temperature for 4 days, with shaking for part of the time. The precipitate was crystallised from water (carbon), giving 6-*carbamoyl*-2 : 3-*dimethylquinoxaline* 1 : 4-*dioxide* (0·95 g.), m. p. 266° (decomp.), dark yellow rhombs (Found: C, 56·25; H, 4·7; N, 17·8. $C_{11}H_{11}O_3N_3$ requires C, 56·6; H, 4·7; N, 18·0%). In a duplicate preparation there appeared to be some hydrolysis of the amide when boiled with water; purification of crystallised material was effected by trituration with dilute ammonia solution.

6-*Dimethylcarbamoyl*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—The ester dioxide was shaken with aqueous dimethylamine (20 c.c.; 25%) for 24 hr., and the residue from evaporation of the solution under reduced pressure was crystallised from methanol–ethyl acetate, giving the *dimethylamide hydrate* (0·85 g.) as yellow needles, m. p. 215° (decomp.) (Found: C, 55·2; H, 5·4; N, 14·85. $C_{13}H_{15}O_3N_3,H_2O$ requires C, 55·9; H, 6·1; N, 15·05%).

2 : 3-*Dimethyl*-6-(N-3-*piperidinopropylcarbamoyl*)*quinoxaline* 1 : 4-*Dioxide*.—6-Carbethoxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (2·1 g.) and 3-piperidinopropylamine (4·5 c.c.) were stirred at 95° for 1½ hr. Most of the excess of amine was evaporated under reduced pressure; the product crystallised when the residue was dissolved in warm benzene. Recrystallisation gave 2 : 3-*dimethyl*-6-(N-3-*piperidinopropylcarbamoyl*)*quinoxaline* 1 : 4-*dioxide* (0·45 g.), m. p. 172—173° (Found: N, 15·35. $C_{19}H_{26}O_3N_4$ requires N, 15·65%).

2 : 3-*Dimethylquinoxaline*-6-*hydroxamic Acid* 1 : 4-*Dioxide*.—Boiling methanolic solutions of hydroxylamine hydrochloride (5·35 g. in 27·5 c.c.) and potassium hydroxide (6·4 g. in 16 c.c.) were cooled quickly to 30—40° and mixed, the mixture cooled in ice, and 6-carbethoxy-2 : 3-dimethylquinoxaline 1 : 4-dioxide (10 g.) added. After 3 days the mixture was poured into water (400 c.c.), and acidified with acetic acid. The precipitated *hydroxamic acid* crystallised from 40% aqueous acetic acid as the *monohydrate* (4·1 g.), m. p. 230—232° (Found: C, 49·8; H, 4·9; N, 15·9. $C_{11}H_{11}O_4N_3,H_2O$ requires C, 49·45; H, 4·85; N, 15·7%).

6-*Acetyl*-2 : 3-*dimethylquinoxaline* 1 : 4-*Dioxide*.—A solution of 6-acetyl-2 : 3-dimethylquinoxaline (5 g.) in 2·1M-peracetic acid (36 c.c.) was kept at ordinary temperature for 10 hr. and then at 50° for 8 hr. The material obtained by concentration below 50° was recrystallised from water, giving 6-*acetyl*-2 : 3-*dimethylquinoxaline* 1 : 4-*dioxide* (2 g.), m. p. 160—162° (Found: C, 62·35; H, 5·35; N, 12·05. $C_{12}H_{12}O_3N_2$ requires C, 62·1; H, 5·15; N, 12·05%).

The *oxime*, recrystallised from 50% acetic acid, had m. p. 244—246° (Found: C, 58·2; H, 5·25; N, 17·2. $C_{12}H_{13}O_3N_3$ requires C, 58·3; H, 5·25; N, 17·0%).

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