626. *The Preparation of Benziminazoles and Benzoxazoles from Schiff's Bases. Part I.*

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2-Phenyl-benziminazoles and -benzoxazoles have been prepared in excellent yield by the dehydrogenation of the Schiff's bases prepared from *o*-phenylenediamine and *o*-aminophenol respectively. Lead tetra-acetate has been used to effect these cyclisations.

2-SUBSTITUTED benziminazoles are conveniently prepared by the oxidation of a mixture of *o*-phenylenediamine and an aldehyde (Weidenhagen, *Ber.*, 1936, **69**, 2263), using cupric acetate as the oxidising agent. It has been pointed out (Weidenhagen and Weedon, *Ber.*, 1938, **71**, 2347) that the reaction proceeds by cyclisation of the mono-Schiff's base first obtained; in practice, it is often expedient to isolate the Schiff's base and to oxidise it in a subsequent operation (*idem, ibid.*, p. 2350). Whilst attempting to prepare 5(6)-*nitro*-2-p-*nitrophenylbenziminazole* by this method we found the low solubility of the corresponding Schiff's base (*i.e.*, 4-*nitro*-N-p'-*nitrobenzylidene*-o-*phenylenediamine*) a disadvantage. Furthermore, when the oxidation was carried out (in nitrobenzene) the product formed a copper derivative which was difficult to convert into the free base.

In view of the powerful dehydrogenating properties of lead tetra-acetate (*e.g.*, Hahn, Kappes, and Ludwig, *Ber.*, 1934, **67**, 686) the preparation was attempted using this reagent, and 5(6)-nitro-2-*p*-nitrophenylbenziminazole was obtained in high yield. The reaction was extended to the general synthesis of 2-phenylbenzoxazoles (including 2-styrylbenzoxazole, cf., Brown and Kon, *J.*, 1948, 2147), high yields being obtained in most cases. Thus, whereas 2-*p*-nitrophenyl- and 2-*m*-nitrophenyl-benzoxazoles were prepared by Skraup and Moser (*Ber.*, 1922, **55**, 1080) in yields of 12% and 4%, respectively, the method now described gives yields of 80% and 70%.

The Schiff's base is dissolved or suspended in acetic acid or benzene; on the addition of one molecular equivalent of lead tetra-acetate the temperature of the mixture rises and the whole reaction is completed in two or three minutes. Further, it is not always necessary to isolate the Schiff's base, good yields of 2-*p*-nitrophenylbenzoxazole being obtained directly from the oxidation of a mixture of *p*-nitrobenzaldehyde and *o*-aminophenol with lead tetra-acetate.

It was shown that the nitrophenylbenzoxazoles could be readily reduced to the corresponding amines. With the exception of 5(6)-nitro-2-*p*-nitrophenylbenziminazole, only compounds derived from unsubstituted *o*-phenylenediamine and *o*-aminophenol are described in this communication. It is hoped to describe the *Bz*-substituted compounds more fully later.

The application of this method of ring closure to other types of compounds is being studied.

EXPERIMENTAL.

(All m.p.s were determined with Anschütz thermometers.)

Schiff's Bases.—The Schiff's bases, detailed in Table I, were prepared by the general method described for *N-m'*-nitrobenzylidene-*o*-phenylenediamine. Other Schiff's bases were prepared by methods already described in the literature.

N-m'-*Nitrobenzylidene*-o-*phenylenediamine*. *m*-Nitrobenzaldehyde (7·5 g.) in ethanol (25 ml.) was added to a solution of *o*-phenylenediamine (5·4 g.) in boiling ethanol (25 ml.). The mixture was boiled for 5 minutes and cooled, and the product (8 g.) removed by filtration. Recrystallisation from ethanol gave red needles, m. p. 108°, of the Schiff's base (Found : N, 17·1. $C_{13}H_{11}O_2N_3$ requires N, 17·4%).

TABLE I.

Schiff's base.	Crystn. solvent.	Colour.	M. p.	Analysis, N%, found.	required.
N-m'-Nitrobenzylidene-*o*-phenylenediamine	A	red	108°	17·1	17·4
N-p'-*Cyanobenzylidene*-o-*phenylenediamine*	A	orange	138—140	18·9	19·0
4-*Nitro*-N-p'-*nitrobenzylidene*-o-*phenylenediamine*	C	red	ca. 340 (decomp.)	19·2	19·6
2-(p-*Acetamidobenzylideneamino*)*phenol*	A	pale yellow	182—183	10·8	11·0
2-(3' : 4'-*Methylenedioxybenzylideneamino*)*phenol*	B	pale yellow	107	5·7	5·8
2-(p-*Chlorobenzylideneamino*)*phenol*	B	pale yellow	117	[1]	[1]

These Schiff's bases all crystallised in needles.
Crystallisation solvents used were : A = ethanol, B = aqueous ethanol, and C = dioxan.

[1] Found : N, 6·1; Cl, 15·3. $C_{13}H_{10}ONCl$ requires N, 6·0; Cl, 15·3%.

Benziminazoles and Benzoxazoles.—The benziminazoles and benzoxazoles, detailed in Table II, were obtained by treatment of the corresponding Schiff's base, in benzene or acetic acid, with one molecular equivalent of lead tetra-acetate. After a few minutes the product was isolated by filtration, by dilution and filtration, or by dilution of the solution and removal of the solvent (by steam-distillation in the case of benzene). The amount of Schiff's base employed for each preparation varied from 1 g. to 20 g.

TABLE II.

Compound.	Crystn. solvent.	Colour.	M. p.	Yield, %.	Analysis, N%,	
					found.	required.
Benziminazoles.						
2-*m*-Nitrophenyl	D	yellow	207—208°	95	17·8	17·6
2-*p*-Nitrophenyl	A	yellow	329—330	90	17·6	17·6
2-*p*-Cyanophenyl	E	white	260	80	[1]	[1]
5(6)-*Nitro*-2-p-*nitrophenyl*	C	yellow	358	80	19·8	19·7
Benzoxazoles.						
2-Phenyl	B	yellow	102	70	7·3	7·2
2-*p*-Nitrophenyl [2]	C or F	pale yellow	268	80	11·8	11·7
2-*m*-Nitrophenyl	F	pale yellow	211—212	70	11·8	11·7
2-p-*Acetamidophenyl*	E	white	212	95	11·2	11·1
2-p-*Dimethylaminophenyl* [3]	B	pale yellow	182—183	40	11·9	11·8
2-p-*Chlorophenyl*	A	pale yellow	151—152	76	[4]	[4]
2-*p*-Methoxyphenyl	B	white	99	75	6·2	6·2
2-Styryl [5]	B	colourless	81 [6]	56	6·5	6·3
2-(3′ : 4′-*Methylenedioxyphenyl*)	A	[7]	151—152	63	[8]	[8]

Crystallisation solvents used were : A = ethanol, B = aqueous ethanol, C = glacial acetic acid, D = dilute acetic acid, E = chloroform, and F = xylene.

[1] Found : C, 76·8; H, 3·9; N, 19·1. Calc. for $C_{14}H_9N_3$: C, 76·7; H, 4·1; N, 19·2%.

[2] 2-*p*-Nitrophenylbenzoxazole was also prepared directly by heating a mixture of *p*-nitrobenzaldehyde (1·5 g.) and *o*-aminophenol (1·1 g.) in hot glacial acetic acid (35 ml.) with lead tetra-acetate (4·5 g.). The crude solid, on crystallisation from xylene (charcoal), gave the benzoxazole in pale yellow needles, m. p. 268°.

[3] Prepared in benzene; when acetic acid was used the product was a plastic solid difficult to purify.

[4] Found : N, 6·15; Cl, 15·6. $C_{13}H_8ONCl$ requires N, 6·1; Cl, 15·5%.

[5] Prepared from 2-(cinnamylideneamino)phenol [m. p. 90° (Found : N, 6·2. Calc. for $C_{15}H_{13}ON$: N, 6·3%). Möhlau and Adams (*Z. Farbenindustrie*, 1906, **5**, 402) claim m. p. 79°].

[6] Picrate, m. p. 166°.

[7] Whereas all the benziminazoles and the other benzoxazoles crystallised in needles, the 2-(3′ : 4′-methylenedioxyphenyl) compound was normally obtained in plates, seldom in needles.

[8] Found : C, 70·3; H, 4·0; N, 5·8. $C_{14}H_9O_3N$ requires C, 70·4; H, 3·8; N, 5·9%.

6-*Nitro*-2-*phenylbenzoxazole*. 2-Phenylbenzoxazole (6 g.) was added slowly (10 mins.) to nitric acid (45 ml.; *d* 1·5) and the mixture set aside for 30 minutes at room temperature. The nitration mixture was poured into water (150 ml.), and the pale yellow precipitate (7·4 g.) removed by filtration. Crystallisation from acetic acid gave yellow needles (6·1 g.), m. p. 178—180° (Found : N, 12·0. Calc. for $C_{13}H_8O_3N_2$: N, 12·0%).

6-*Amino*-2-*phenylbenzoxazole*. A suspension of 6-nitro-2-phenylbenzoxazole (2·4 g.) in glacial acetic acid (40 ml.) was hydrogenated at room temperature in the presence of Adams's catalyst (initial hydrogen pressure : 50 lbs. per sq. in.). After 10 minutes the product (1·5 g.) was isolated by dilution with water. Recrystallisation from aqueous ethanol gave long pale yellow needles, m. p. 210—211° (Found : N, 13·1. Calc. for $C_{13}H_{10}ON_2$: N, 13·3%).

2-m-*Aminophenylbenzoxazole*. This compound was similarly prepared (yield, 67%). It crystallised from ethanol in pale pink needles, m. p. 178° (Found : N, 13·4. Calc. for $C_{13}H_{10}ON_2$: N, 13·3%).

2-p-*Aminophenylbenzoxazole*. A mixture of 2-*p*-acetamidophenylbenzoxazole (4·8 g.) water (45 ml.), and sulphuric acid (5 ml.; *d* 1·85) was boiled under reflux for 1 hour, and then cooled and made alkaline with 50% sodium hydroxide solution. The solid, removed by filtration, gave, on recrystallisation from aqueous ethanol, light brown needles (2·7 g.), m. p. 169—170° (Found : N, 13·9%).

We thank Dr. G. M. Dyson for his interest in this work, the Directors of British Chemicals and Biologicals Limited for permission to publish, the Analytical Division of this Company for all analyses, and Mr. J. A. Coombs for experimental assistance.

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[*Received, June 3rd*, 1949.]