CCXCIV.—*The Isomerism of the Oximes. Part XXXV. The Amidoximes.*

By Oscar L. Brady and Frank Herbert Peakin.

Amidoximes are produced in a number of ways, by the action of hydroxylamine on nitriles (Lossen and Schifferdecker, *Annalen*, 1873, **166**, 295; Tiemann, *Ber.*, 1884, **17**, 128), on benzamidines (Pinner, *Ber.*, 1884, **17**, 185), on benziminoethyl ethers (Lossen, *Ber.*, 1884, **17**, 1588), on thioamides (Tiemann, *Ber.*, 1886, **19**, 1668), and on imidochlorides (Ley, *Ber.*, 1898, **31**, 240); by the action of ammonia on ethylbenzhydroxamic acids (Lossen, *loc. cit.*) and on hydroxamyl chlorides (Werner, *Ber.*, 1894, **27**, 2197); and by the reduction of nitrosolic acids and of hydroxyamidoximes (Wieland and Bauer, *Ber.*, 1906, **39**, 1485). These methods of preparation generally leave the choice open between the following structures:

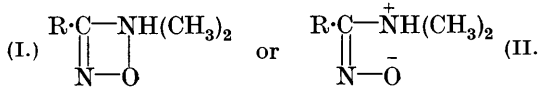
Amidoxime Hydroxyamidine

This is, perhaps, best brought out by their formation from hydroxamyl chlorides and ammonia, $R{\cdot}CCl{:}NOH + NH_3 \longrightarrow R{\cdot}C(NH_2){:}NOH$, and from imidochlorides and hydroxylamine, $R{\cdot}CCl{:}NH + NH_2{\cdot}OH \longrightarrow R{\cdot}C{\cdot}NH(OH)(:NH)$. The reactions and general properties of the compounds are, however, best explained by the amidoxime structure; they form salts with alkalis like the oximes and do not reduce Fehling's solution at all readily as do the *N*-substituted hydroxylamines. The numerous ring closures the amidoximes undergo are also best represented by means of the amidoxime structure (compare, for example, Tiemann and Krüger, *Ber.*, 1884, **17**, 1696; Werner and Herberger, *Ber.*, 1899, **32**, 2691).

In view, however, of the possibility of tautomeric change, it is not surprising that stereoisomeric forms of the amidoximes have not been obtained. An attempt has now been made to prepare such compounds by blocking the tautomeric system. For this purpose m-*nitrobenzodimethylamidoxime*, $NO_2{\cdot}C_6H_4{\cdot}C(:NOH){\cdot}NMe_2$, has been investigated. This compound was prepared by the action of dimethylamine on *m*-nitrobenzhydroxamyl chloride. Only one isomeride was formed and all attempts to bring about stereoisomeric change were unsuccessful. With hydrogen chloride it yielded a monohydrochloride which regenerated the original amidoxime with alkalis, ultra-violet light was without action upon it (compare Brady and McHugh, J., 1924, **125**, 547), and the oxime was recovered unchanged by hydrolysis of its benzoyl derivative (com-

pare Brady and Thomas, J., 1922, **121**, 2099; Brady and Grayson, J., 1924, **125**, 1418).

A possible explanation of the failure to obtain a second isomeride is that the amidoxime has a betaine-like structure,



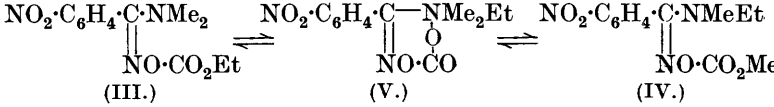
(I.) or (II.)

Although there is evidence for the existence of *trans*-betaines (Pfeiffer and Haefelin, *Ber.*, 1922, **55**, 1769), the occurrence of the compound of structure (II) would probably be enough to stabilise one stereoisomeric form. That inner salt formation occurs seems likely in view of the facts that the substance has a pronounced yellow colour, yields colourless solutions with acids, and has very feeble acidic properties, the alkali salts being almost completely hydrolysed by water. Moreover, if the hydroxyl group was intact, one would expect it to be methylated fairly readily, but attempts to prepare the *O*-methyl ether were unsuccessful, either no reaction taking place or decomposition occurring with the formation of m-*nitrobenzodimethylamide* and *N*-methylhydroxylamine; the latter reaction was probably due to the formation of an *N*-ether which hydrolyses with great ease:

$$NO_2\cdot C_6H_4\cdot C(:NOH)\cdot NMe_2 \longrightarrow NO_2\cdot C_6H_4\cdot C(:NMe:O)\cdot NMe_2 \longrightarrow NO_2\cdot C_6H_4\cdot CO\cdot NMe_2 + NHMe\cdot OH.$$

An attempt to prepare the required *O*-methyl ether from m-*nitrobenzmethoxamyl chloride* and dimethylamine gave, rather unexpectedly, only *m*-nitrobenzoic acid.

As it was impossible to obtain the *O*-ether for study, the *carbethoxy*-derivative (III) of *m*-nitrobenzodimethylamidoxime and the *carbomethoxy*-derivative (IV) of m-*nitrobenzomethylethylamidoxime* were prepared.



(III.) (V.) (IV.)

These were, however, found to be distinct compounds and did not pass into one another (V) under the usual conditions of betaine change. The failure of this experiment and the fact that *m*-nitrobenzodimethylamidoxime, unlike benzamidoxime (Tiemann, *Ber.*, 1891, **24**, 4164; Pinnow, *ibid.*, p. 4171), does not undergo a Beckmann change make it impossible to suggest a configuration for the compound.

EXPERIMENTAL.

m-*Nitrobenzodimethylamidoxime.*—A solution of dimethylamine in alcohol was prepared by adding sodium ethoxide solution (from sodium, 6 g., and absolute alcohol, 100 c.c.) to a solution of dimethylamine hydrochloride (21 g.) in absolute alcohol (50 c.c.) cooled in ice; the precipitated sodium chloride was removed, and the filtrate added gradually to an ice-cooled solution of *m*-nitrobenzhydroxamyl chloride (24 g.), prepared by Werner's method (*Ber.*, 1894, **27**, 2846), in absolute alcohol (50 c.c.). Heat was evolved, the liquid became deep yellow, and a pale yellow precipitate was formed. After 12 hours, the precipitated *mm'*-dinitrodiphenylfuroxan (7 g.) was removed, and the alcohol evaporated from the mother-liquor on the water-bath as far as possible. On cooling, a mass of crystals (12 g.) separated and was collected. The residual solution was treated with concentrated hydrochloric acid (20 c.c.), extracted with chloroform to remove non-basic impurities, and made alkaline with ammonia. The yellow crystalline precipitate (1·7 g.) was added to the 12 g. previously obtained and crystallised three times from dilute alcohol or from benzene and light petroleum, giving m-*nitrobenzodimethylamidoxime* in yellow prisms, m. p. 160° (Found : N, 20·3. $C_9H_{11}O_3N_3$ requires N, 20·1%). The compound is sparingly soluble in water and in light petroleum, but readily soluble in alcohol, benzene, and chloroform. It dissolves in dilute acids to colourless solutions, but is insoluble in 2*N*-sodium hydroxide. Sodium ethoxide in alcohol gives a deep red coloration, which is destroyed by the addition of water.

Two reactions occur when dimethylamine acts upon the hydroxamyl chloride, leading to the production of the amidoxime and the diphenylfuroxan :

$$R\cdot CCl{:}NOH + 2NHMe_2 \longrightarrow R\cdot C(NMe_2){:}NOH + NHMe_2,HCl.$$

$$2R\cdot CCl{:}NOH + 2NHMe_2 \longrightarrow \begin{matrix} RC{=}\!\!-\!\!{=}CR \\ \| \quad\quad \| \\ N\cdot O\cdot N{:}O \end{matrix} + 2NHMe_2,HCl.$$

Addition of the solution of the hydroxamyl chloride to that of the amine reduces the yield of the dimethylamidoxime.

m-Nitrobenzodimethylamidoxime, apart from some slight but profound decomposition, is unchanged by exposure in benzene solution in a silica vessel for 48 hours to the light of a quartz mercury-vapour lamp. It is unaffected by shaking with excess of methyl sulphate and sodium hydroxide solution. A quantity (2 g.) in benzene (30 c.c.) was boiled under reflux for 3 hours with dry silver oxide (2·3 g.) and methyl iodide (3·3 g.). After the solid had been separated and washed with hot benzene, the solution and washings

were evaporated and the residual oil was induced to crystallise by cooling in a freezing mixture and scratching. The crystals were pressed on a porous tile and crystallised from alcohol and then from light petroleum, m-*nitrobenzodimethylamide* being obtained in colourless prisms, m. p. 81° (Found : N, 14·7. $C_9H_{10}O_3N_2$ requires N, 14·4%). This compound was identified by comparison with a specimen prepared by adding *m*-nitrobenzoyl chloride (5 g.) in ether (15 c.c.) to a mixture of dimethylamine hydrochloride (2·2 g.) and 2*N*-sodium hydroxide (27 c.c.), cooling the whole in ice, and shaking it. After 12 hours, the ether and the solid were separated from the water and the latter was extracted with benzene. The solid and the ethereal and benzene solutions were heated to remove the solvents and the solid obtained on cooling was crystallised as before.

The usual reagents do not bring about the Beckmann change of *m*-nitrobenzodimethylamidoxime. Phosphorus pentachloride in ether and concentrated sulphuric acid at 130° were without action and benzenesulphonyl chloride and dry sodium carbonate in chloroform gave *benzenesulphonyl*-m-*nitrobenzodimethylamidoxime*, which separated from alcohol in colourless crystals, m. p. 138° (Found : N, 12·5. $C_{15}H_{15}O_5N_3S$ requires N, 12·0%). With benzoyl chloride and 2*N*-sodium hydroxide, *benzoyl*-m-*nitrobenzodimethylamidoxime* was formed, which crystallised from dilute alcohol in yellow prisms, m. p. 152° (Found : N, 13·6. $C_{16}H_{15}O_4N_3$ requires N, 13·4%).

O-*Methyl*-m-*nitrobenzamidoxime*.—*m*-Nitrobenzamidoxime (16 g.), prepared by Schöpff's method (*Ber.*, 1885, **18**, 1063), was dissolved in sodium hydroxide solution (3·5 g. in 75 c.c. of water) and shaken with methyl sulphate (15 g.); after 30 minutes an additional 5 g. of methyl sulphate was added. The dark oil produced was extracted with benzene; after removal of the solvent it slowly solidified. After four crystallisations from alcohol O-*methyl*-m-*nitrobenzamidoxime* was obtained in bright yellow needles, m. p. 75° (Found : N, 21·5. $C_8H_9O_3N_3$ requires N, 21·5%). No stereoisomeric change occurs when this compound is exposed in benzene to ultra-violet light.

m-*Nitrobenzmethoxamyl Chloride*.—When a solution of the above *O*-ether (9 g.) in concentrated hydrochloric acid (8 c.c.), cooled in ice, was treated with a concentrated solution of sodium nitrite (4 g.), a vigorous reaction occurred with the evolution of nitrogen and separation of a red oil. On distillation in steam and crystallisation from dilute alcohol, m-*nitrobenzmethoxamyl chloride* was obtained in pale yellow needles, m. p. 51° (Found : N, 13·5. $C_8H_7O_3N_2Cl$ requires N, 13·1%).

Carbethoxy-m-*nitrobenzodimethylamidoxime*. — *m*-Nitrobenzodi-

methylamidoxime (4 g.) was suspended in dry chloroform (15 c.c.) and treated with ethyl chloroformate (0·9 c.c.) in chloroform (5 c.c.). After some hours the mixture was shaken with water (30 c.c.) and the chloroform layer was dried over sodium sulphate and evaporated; the oil obtained solidified when kept for some days in a desiccator and on crystallising twice from benzene and light petroleum gave *carbethoxy*-m-*nitrobenzodimethylamidoxime* in very pale yellow prisms, m. p. 94° (Found: N, 14·9. $C_{12}H_{15}O_5N_3$ requires N, 14·9%). When it was heated at 180° for 5 minutes, some decomposition occurred, but most of the original compound could be recovered by crystallisation.

Carbomethoxy-m-*nitrobenzomethylethylamidoxime.*—*m*-Nitrobenzhydroxamyl chloride (24 g.) in alcohol (50 c.c.) was treated with methylethylamine solution obtained from the hydrochloride (23 g.) and sodium ethoxide in alcohol (150 c.c.), the reaction mixture being cooled in ice. After 12 hours, concentrated hydrochloric acid (12 c.c.) was added, and the alcohol evaporated on the water-bath. Water (100 c.c.) was added to the residue and the solution was decanted from a red resin, which was further extracted with dilute acid. The united extracts were washed with chloroform to remove resin and the aqueous layer was made alkaline with sodium hydroxide. The precipitated oil soon solidified and crystallisation from alcohol gave m-*nitrobenzomethylethylamidoxime* in pale yellow prisms, m. p. 123° (Found: N, 18·9. $C_{10}H_{13}O_3N_3$ requires N, 18·8%). This compound closely resembles in its properties the dimethyl analogue. Treated with methyl chloroformate in the way that substance was with ethyl chloroformate, it gave *carbomethoxy*-m-*nitrobenzomethylethylamidoxime*, which crystallised from benzene and light petroleum in colourless prisms, m. p. 87° (Found: N, 14·9. $C_{12}H_{15}O_5N_3$ requires N, 14·9%). A mixture of equal quantities of this compound and carbethoxy-*m*-nitrobenzodimethylamidoxime (m. p. 94°) melted at about 65°. It underwent no appreciable change on being heated at 160° for 5 minutes.

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