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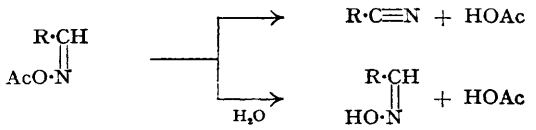
249. *The Isomerism of the Oximes. Part XXXIX. The Hydrolysis of Acyl Derivatives.*

By M. Benger and O. L. Brady.

The mechanism of the alkaline hydrolysis of acyl derivatives of substituted benzaldoximes has been studied and it has been shown that the main reactions are attack by hydroxyl ions (1) at the methine-hydrogen atom, resulting in the formation of the nitrile, and (2) at the carbonyl-carbon atom, resulting in the formation of the oxime. The effects of different substituents in the nucleus and of varying the acyl group have been investigated and many of the apparently anomalous results obtained in the hydrolysis of acyl-aldoximes have been explained.

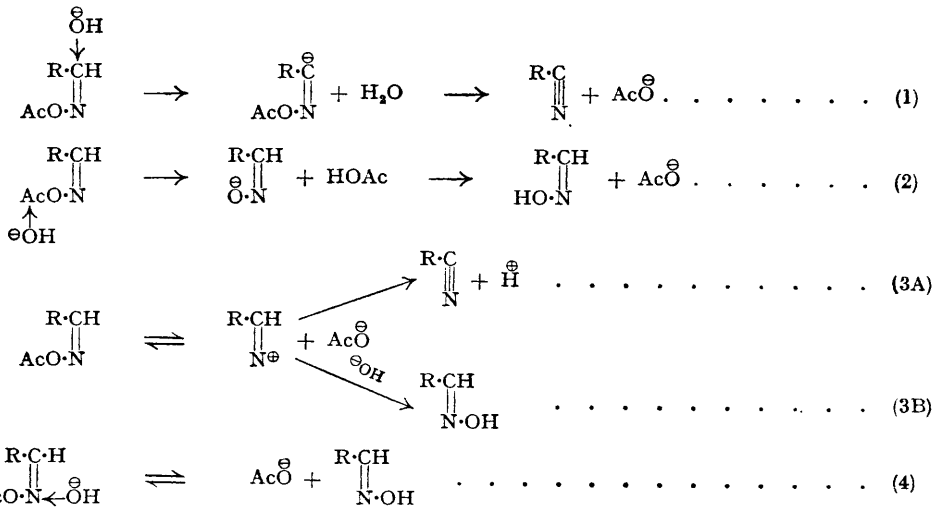
When the acetyl derivative of an aromatic β-aldoxime is warmed in the solid state with 2N-sodium carbonate, or when its solution in acetic anhydride is shaken with a large excess of the same reagent, the main reaction is the elimination of acetic acid and the formation of nitrile, but some β-aldoxime is also formed :



Certain exceptions to this reaction are mentioned below.

When the sodium carbonate is replaced by 2N-sodium hydroxide the amount of nitrile formed is smaller and that of β-aldoxime larger (Hantzsch, *Ber.*, 1891, **24**, 38; *Z. physikal. Chem.*, 1894, **13**, 509; Brady and McHugh, *J.*, 1925, **127**, 2423; Hauser and Sullivan, *J. Amer. Chem. Soc.*, 1933, **55**, 4611; Hauser and Jordan, *ibid.*, 1935, **57**, 2450).

The decomposition of an acetyl-β-aldoxime in the presence of alkali can be represented as taking place in four ways :



Mechanism (1) consists in the removal of a proton from the methine group by a hydroxyl ion, and gives the nitrile as the sole product. Mechanism (2) consists in attack by a hydroxyl ion at the carbonyl group and corresponds to acyl–oxygen fission in the alkaline hydrolysis of esters (Day and Ingold, *Trans. Faraday Soc.*, 1941, **37**, 686). This will yield oxime only. Mechanism (3) represents ionisation of the acetyl derivative or, in other words, escape of the acetoxyl group with the pair of electrons binding it to nitrogen, corresponding to the unimolecular alkyl–oxygen fission in the alkaline hydrolysis of esters, for which evidence is supplied by the work of Kenyon and his collaborators (Kenyon, Partridge, and Phillips, *J.*, 1936, 85; Hills, Kenyon, and Phillips, *ibid.*, p. 582; Kenyon, Partridge, and Phillips, *J.*, 1937, 216). The cation produced may behave in two ways : extrusion of the methine-hydrogen as a proton may occur

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with the formation of nitrile (3A), or attack by a hydroxyl ion with the formation of oxime (3B). In the case of the decomposition of acyl-β-aldoximes it is unlikely that oxime formation occurs to any considerable extent by this mechanism, as the addition of hydroxyl to the cation would give the more stable α-aldoxime, whereas, in practice, the oxime formed consists of the nearly pure β-isomeride (Brady and McHugh, Sullivan, and Hauser, *locc. cit.*). The nitrogen cation may be more stable than an alkyl cation, so the speed of mechanism (3A) relative to (2) may be greater than in the case of esters, and consequently ionisation may play a greater part in the hydrolysis of acyl-β-aldoximes than in the case of esters.

As pointed out by Day and Ingold (*loc. cit.*), referring to esters, if the hydroxyl ion is replaced by successive weaker nucleophilic reagents, both acyl and alkyl attack will be reduced in speed and may ultimately become slower than the rate of ionisation, which suggests that the increase in the proportion of nitrile formed when 2N-sodium carbonate is employed may be due to its formation to a greater extent by mechanism (3A).

Hantzsch (*Z. physikal. Chem.*, 1894, **13**, 509) and Ley (*ibid.*, 1895, **18**, 376) measured the velocity of acid formation when various acetyl-β-aldoximes (M/100) in aqueous alcohol were decomposed by sodium acetate (M/100). They found that the reaction, under these conditions, was of the first order; their results thus do not rule out the possibility of the first-order mechanism (3A), but they cannot safely be adduced in its support owing to the ambiguity of the reaction mechanism and the complications from possible stereoisomeric change during the experiments, which would be favoured by the liberated proton. Unfortunately no evidence is produced about the nature of the compounds formed under the experimental conditions of the velocity measurements, it being assumed that nitrile and acetic acid were the only products. Hantzsch also investigated the reaction between acetyl-β-benzaldoxime and sodium carbonate, both in M/200-solution, but obtained inconstant values for a second-order reaction about 100 times faster than the previous one. He does not seem to have considered the possibility of a first-order reaction in this case, and does not give full experimental values.

The last-mentioned mechanism (4), *i.e.*, attack by hydroxyl at the nitrogen with the extrusion of the acetoxyl ion leading to oxime, a replacement reaction, is ruled out, as it would involve stereoisomeric change with the production of the α-aldoxime.

Oxime formation in the presence of 2N-sodium hydroxide is therefore due essentially to mechanism (2); it remains to be considered whether mechanism (1) or (3A) is principally concerned in nitrile formation in the alkaline decomposition of acetyl-β-aldoximes.

Some light is thrown on this question by the effect of substituents in the benzene nucleus on the proportions of nitrile and oxime formed by the action of 2N-sodium hydroxide at 0° on various acetyl-β-aldoximes, that is the proportion of (1) and/or (3A) compared with (2). The results are given in Table I.

TABLE I.

X in β-X·C_6H_4·CH:N·OAc.	Nitrile, %.	Oxime, %.	Total, %.	Nitrile, % of total.
o-NO_2	85	0	85	100
p-NO_2	75	21	96	78
p-Me	61	27	88	70
H	61	30	91	67
p-MeO	66	33	99	66
m-NO_2	57	31	88	65
3 : 4-CH_2O_2	48	48	96	50
3 : 4-$(MeO)_2$	36	55	91	40
2 : 4-$(MeO)_2$	31	64	95	32

We do not claim great accuracy for these figures owing to difficulties in working with the unstable acetyl-β-aldoximes, but the positions of the *o*- and *p*-nitro-derivatives at the head of the Table and of the 3 : 4-methylenedioxy- and 3 : 4- and 2 : 4-dimethoxy-derivatives at the bottom is sufficiently significant to establish the influence of the electronic properties of the substituent in the benzene nucleus on the proportion of nitrile to oxime formed. The results are probably not accurate enough to fix the relative positions of the compounds in which X is *p*-Me, H, *p*-OMe, or *m*-NO_2. Hauser and his co-workers (*loc. cit.*) have investigated the same reaction in the case of four acetyl β-aldoximes; they obtained a much smaller proportion of nitrile, but their order was *p*-nitro > *m*-nitro > 3 : 4-methylenedioxy > *p*-methoxy.

Now the negative inductive effect of the nitro-group will facilitate attack by hydroxyl ions at the methine-carbon atom, favouring mechanism (1), and will also facilitate attack by hydroxyl ions at the carbonyl group, the latter less effectively owing to its remoteness from

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the activating group. The inductive effect will hinder the ionisation demanded by mechanism (3A).

The negative mesomeric and electromeric effects of the nitro-group would facilitate the attack at the methine-hydrogen atom, and if the conjugation extends effectively to the oxygen atom would facilitate attack at the carbonyl group owing to the inductive effect of the positive oxygen atom.*

Since the effect of the nitro-group is always to hinder the ionisation mechanism (3A), the greater yield of nitrile from acetyl-β-*p*-nitrobenzaldoxime than from acetyl-β-benzaldoxime indicates that in this case mechanism (3A) plays a small part in the reaction and that mechanism (1) is the controlling factor.

The influence of methoxyl groups is more difficult to interpret. The negative inductive effect would be the same as with the nitro-group—to facilitate mechanisms (1) and (2) and to hinder mechanism (3A). The smaller proportion of nitrile to oxime obtained in the decomposition of, for example, acetyl-β-2 : 4-dimethoxybenzaldoxime compared with acetyl-β-benzaldoxime suggests again that mechanism 3A is less important in nitrile formation than is mechanism (1).

The action of sodium hydroxide on the propionyl derivatives of some β-aldoximes has also been investigated. The results obtained when the solid propionyl-β-aldoxime was treated with 2N-sodium hydroxide are shown in Table II, and those for a solution of the propionyl-β-aldoxime in propionic anhydride shaken with a large excess of 2N-sodium hydroxide are shown in Table III. The latter method was employed because it was found impossible to isolate the propionyl derivatives sufficiently pure.

TABLE II.

X in β-X·C_6H_4·CH:N·O·COEt.	Nitrile, %.	Oxime, %.	Total.	Nitrile, % of total.
p-NO_2	63	36	99	63
3 : 4-CH_2O_2	41	57	98	42

TABLE III.

X in β-X·C_6H_4·CH:N·O·COEt.	Nitrile, %.	Oxime, %.	Total.	Nitrile, % of total.
p-Cl	77	22	99	78
p-Me	73	21	94	78
p-MeO	65	32	97	67

The propionyl derivatives are less easily decomposed than the corresponding acetyl compounds, and it was necessary to leave them in contact with the reagent for a much longer period, thus affording greater opportunity of stereoisomeric change during the reaction; the results, however, are in the same order as those from the acetyl-β-aldoximes.

The same general effects are observed in the hydrolysis of the acetyl derivatives of the substituted cinnamaldoximes, as shown in Table IV.

TABLE IV.

X in β-X·C_6H_4·CH:CH·CH:N·OAc.	Nitrile, %.	Oxime, %.	Total.	Nitrile, % of total.
m-NO_2	78	17	95	82
H	69	27	96	72
p-MeO	54	38	92	59
o-MeO	48	49	97	49

The effect of changes in the nature of the acyl group has also been investigated; since suitable acyl derivatives could not be prepared from β-aldoximes those of α-aldoximes have been used, but it was necessary in some cases to carry out the hydrolysis at a higher temperature owing to the greater stability of acyl-α-aldoximes.

It was found that propionyl- and *n*-heptoyl-α-aldoximes, on hydrolysis at 100° with 2N-sodium hydroxide, gave only the α-aldoximes, and a similar result was obtained with mono-

* From a kinetic study of the alkaline hydrolysis of the acetyl derivatives of nuclear-substituted acetophenone oximes, in which there is no methine-hydrogen atom open to attack, it has been found that varying a *para*-substituent has very little influence on the rate constant of the hydrolysis; indeed the effect seems to be in the opposite sense to that here suggested; *e.g.*, *p*-NO_2·C_6H_4·CMe:N·OAc is hydrolysed about 6% slower than *p*-MeO·C_6H_4·CMe:N·OAc. The kinetics, however, are complicated owing to the varying acid strengths of the oximes produced in the reaction which compete differentially for $\overset{\ominus}{O}H$ ions (Brady and Miller, unpublished).

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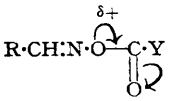
chloroacetyl derivatives, but trichloroacetyl-α-*p*-nitro- and trichloroacetyl-α-3 : 4-methylenedioxy-benzaldoximes with 2N-sodium hydroxide at 0° gave 35% and 10% of nitrile, respectively, whilst *o*-nitrobenzoyl-α-*p*-nitrobenzaldoxime gave at 100° 50% of nitrile. Hauser, Jordan, and O'Connor (*J. Amer. Chem. Soc.*, 1935, **57**, 2456) have also reported the formation of nitrile, or the corresponding carboxylic acid formed by its hydrolysis, in the decomposition of carbethoxy-α-aldoximes by 2N-sodium hydroxide at 97—100°, obtaining from the carbethoxy-derivatives of α-*m*-nitro- 50%, α-*p*-nitro- 48%, α-*p*-chloro- 83%, α-*p*-methoxy- 31%, and α-3 : 4-methylenedioxy-benzaldoxime 34% of nitrile or acid.

In considering these results, one must bear in mind that normally (an exceptional case is dealt with below) neither β-aldoximes nor α-aldoximes with alkalis give any of the nitrile. In alkaline solution the oximes will exist mainly as anions $R\cdot CH{:}N\cdot O^{\ominus}$ and the high electron density in the neighbourhood of the oxygen atom prevents attack by hydroxyl ions at the methine-hydrogen atom; when the hydrogen of the hydroxyl group is replaced by an acyl group the mesomeric effect, by establishing a positive pole at the oximino-oxygen atom, reduces the electron concentration sufficiently to allow attack at the methine-hydrogen atom provided (*a*) that there are suitable substituents in the benzene nucleus R, and (*b*) that the stereo-chemical structure is favourable :

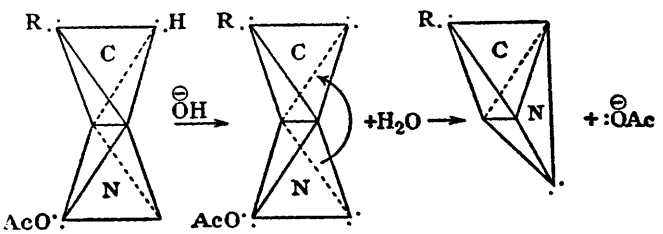


Varying Y will either oppose or reinforce this effect. If Y is electron-repelling it will compete with the oximino-oxygen atom in supplying electrons to the carbonyl oxygen atom, and if electron-attracting it will have the opposite effect.

Where Y is an alkyl group its competition is sufficient to prevent nitrile formation from the acyl-α-aldoxime where the stereochemical structure is unfavourable to the removal of the methine hydrogen, but not enough to prevent it where the stereochemical structure is not unfavourable and the substituent in the benzene nucleus is favourable, that is, in the acyl-β-aldoximes. Where Y is CCl_3 the strong inductive effect will cause a greater demand on the electrons of the oximino-oxygen atom, and the trichloroacetyl derivatives of α-aldoximes yield some nitrile.

Where Y induces sufficient electron-withdrawal, mechanism 3A will come into play (see Ambrose and Brady, *J.*, 1950, 1243), but it cannot be the sole mechanism of nitrile formation in alkaline hydrolysis, since trichloroacetyl-α-*p*-nitrobenzaldoxime gives more nitrile than does trichloroacetyl-α-3 : 4-methylenedioxybenzaldoxime.

Mention has been made above that there is a favourable stereochemical configuration for attack at the methine-hydrogen atom by hydroxyl ions, and some explanation is necessary. Mills (*British Ass. Rept.*, 1932, 47) first suggested that nitrile formation consisted in removal of a proton from the methine group, accompanied by a movement of the nitrogen towards the carbon atom, with the ultimate extrusion of the acetate ion (see figure).



This mechanism was held to explain the fact that the elimination of acetic acid with the formation of nitrile occurred more readily when the methine-hydrogen atom and the acetyl group were on opposite sides of the plane of the carbon–nitrogen double bond, since then the acetyl group would not interfere with the movement of the nitrogen towards the carbon atom.

We think, however, that the greater reluctance of the α- compared with the β-isomeride to yield nitrile is due chiefly to greater difficulty of attack by the hydroxyl ion on the methine-hydrogen atom, owing to the influence of the unshared electrons of the carbonyl-oxygen atom on the methine-hydrogen atom leading perhaps to hydrogen bonding; this can occur in the α-,

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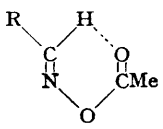
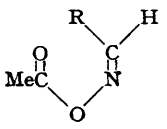
but is less likely in the β-isomeride (for further discussion of this see Ambrose and Brady, *loc. cit.*).



α-Acetyl derivative.



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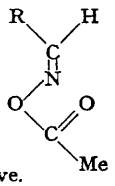
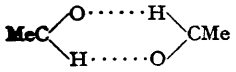


β-Acetyl derivative.

Evidence of hydrogen bonding involving a methine-hydrogen atom appears from the infra-red absorption spectrum of acetaldehyde which has been represented :



(Alexander and Lambert, *Trans. Faraday Soc.*, 1941, **37**, 421).

The considerations here advanced clear up a number of anomalies in the behaviour of acyl derivatives of the aldoximes.

The di- and tri-nitrophenyl derivatives of the aldoximes (Brady and Truszkowski, *J.*, 1924, **125**, 1087; Brady and Klein, *J.*, 1925, **127**, 844), when boiled with 2N-sodium hydroxide, give exclusively nitriles or their hydrolysis products, the acids, and the β-structure has been assigned to them despite the fact that they were formed from α-aldoximes and not from β-aldoximes. The strong electron-withdrawal due to the di- and tri-nitrophenyl groups would, however, greatly favour nitrile formation by mechanisms 1 and 3A and, in addition, there is no carbonyl group to stabilise the methine-hydrogen atom in the α-isomeride. In consequence there is no reason why these compounds should not be given the α-configuration.

The diphenylcarbamyl derivatives prepared by the action of diphenylcarbamoyl chloride on the sodium salts of the α-aldoximes give, on alkaline hydrolysis, nitriles almost exclusively (Brady and Dunn, *J.*, 1913, **103**, 1613); on the other hand the carbamyl- (Conduché, *Ann. Chim. Phys.*, 1908, [viii], **13**, 5), phenylcarbamyl-, naphthylcarbamyl-, phenylethylcarbamyl-, and diethylcarbamyl-α-aldoximes give on alkaline hydrolysis mainly the oximes (Brady and Dunn, *J.*, 1916, **109**, 650; Brady and Ridge, *J.*, 1923, **123**, 2163; Brady and McHugh, *J.*, 1925, **127**, 2414).

These results are explicable when one considers the electron density at the carbamyl nitrogen atom in the light of the strength, as bases, of diphenylamine, ammonia, aniline, naphthylamine, ethylaniline, and diethylamine. Only when two phenyl groups are present is the electron-withdrawal sufficient to cause nitrile formation, and there is little doubt that the diphenyl-carbamyl derivatives have the α-configuration.

Two other earlier difficulties may now be considered. Certain acetyl derivatives of β-aldoximes do not give nitrile on treatment with 2N-sodium carbonate, for example, those of β-5-bromo-3 : 4-dimethoxybenzaldoxime (Brady and Wentworth, *J.*, 1920, **117**, 1045), β-3 : 4-dimethoxybenzaldoxime (Brady and Dunn, *J.*, 1923, **123**, 1783), and β-2 : 4-dimethoxybenzaldoxime (see Experimental section), though they are decomposed by 2N-sodium hydroxide. Here the mesomeric effect is sufficient to prevent attack at the methine-hydrogen atom when the hydroxyl-ion concentration is low.

The aldoximes themselves are not normally converted into nitriles by the action of hydroxyl ions on the methine-hydrogen atom, but α-*o*-nitrobenzaldoxime on heating with aqueous sodium hydroxide readily gives the nitrile (Reissert, *Ber.*, 1908, **41**, 3815; Brady and Goldstein, *J.*, 1926, 1918). The effect of the nitro-group in the *ortho*-position is sufficiently strong to enable a proton to be removed from the methine group without the additional help provided by the carbonyl group of the acyl group.

Experimental.

Preparation of Materials.

Most of the compounds used have been previously described.

β-Oximes.—*β-2 : 4-Dimethoxybenzaldoxime* was prepared by dissolving 2 : 4-dimethoxybenzaldoxime (5 g.) (previously dried over phosphoric oxide) in dry benzene (100 c.c.) at 60°, passing in a rapid stream of dry hydrogen chloride for 15 seconds, and scratching the sides of the vessel. The β-hydrochloride, m. p. 153° (decomp.), was collected and decomposed with 2N-sodium carbonate (large excess), and the precipitated oxime collected and crystallised from benzene in long needles, m. p. 135° (Found : C, 59·9;

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H, 6·0. $C_9H_{11}O_3N$ requires C, 59·7; H, 6·1%). Even with these precautions the preparation failed several times, the hydrochloride giving the α-oxime.

The method of Brady and Dunn (*J.*, 1923, **123**, 1783) for the preparation of β-3 : 4-dimethoxybenzaldoxime was not satisfactory and the following proved much better. α-3 : 4-Dimethoxybenzaldoxime was dissolved in dry ether, and the α-hydrochloride precipitated with dry hydrogen chloride. This was collected, just covered with concentrated hydrochloric acid, and heated on the steam-bath for a few minutes, whereupon it dissolved; the solution was poured into a large excess of well stirred 2N-sodium carbonate, an emulsion being formed which soon deposited colourless crystals of β-3 : 4-dimethoxybenzaldoxime.

Attempts by various methods to prepare β-*o*-methoxy-, β-*o*-ethoxy-, β-2 : 5-dimethoxy-, and β-2 : 4 : 6-trimethoxy-benzaldoxime were unsuccessful.

Acetyl-α-aldoximes.—Prepared by the usual method, *acetyl-α-2 : 4-dimethoxybenzaldoxime* crystallised from benzene–light petroleum in needles, m. p. 89° (Found : C, 58·8; H, 5·9. $C_{11}H_{13}O_4N$ requires C, 59·2; H, 5·8%), and *acetyl-α-2 : 5-dimethoxybenzaldoxime* from the same solvent in needles, m. p. 58° (Found : C, 59·3; H, 5·9%).

Propionyl-α-aldoximes.—The α-aldoxime (5 g.) was dissolved in propionic anhydride (7 c.c.) with slight warming, and the solution cooled in ice–salt, whereupon the propionyl derivative crystallised. It was recrystallised from benzene–light petroleum. Prepared in this way, *propionyl-α-p-nitrobenzaldoxime* crystallised in pale yellow needles, m. p. 112° (Found : C, 54·0; H, 4·3. $C_{10}H_{10}O_4N_2$ requires C, 54·0; H, 4·5%), *propionyl-α-m-* as a colourless powder, m. p. 74° (Found : C, 54·1; H, 4·4%), and *propionyl-α-o-nitrobenzaldoxime* as plates, m. p. 62° (Found : C, 54·2; H, 4·7%), and *propionyl-α-3 : 4-methylenedioxybenzaldoxime* as prisms, m. p. 95° (Found : C, 59·6; H, 5·0. $C_{11}H_{11}O_4N$ requires C, 59·7; H, 5·0%). When, instead of cooling the solution in propionic anhydride it was shaken with an excess of 2N-sodium carbonate and the precipitated solid was recrystallised, *propionyl-α-o-methoxybenzaldoxime* was obtained from benzene–light petroleum as plates, m. p. 45° (Found : C, 63·5; H, 6·0. $C_{11}H_{13}O_3N$ requires C, 63·7; H, 6·3%), *propionyl-α-3 : 4-dimethoxybenzaldoxime* from carbon tetrachloride and light petroleum as prisms, m. p. 66° (Found : C, 60·7; H, 6·2. $C_{12}H_{15}O_4N$ requires C, 60·7; H, 6·3%), and *propionyl-α-p-chlorobenzaldoxime* from light petroleum as plates, m. p. 71° (Found : C, 56·6; H, 4·7. $C_{10}H_{10}O_2NCl$ requires C, 56·7; H, 4·7%). Propionyl-α-*p*-methoxybenzaldoxime did not solidify in the sodium carbonate but was extracted with ether; the solvent was removed and the oil covered with light petroleum and scratched, a white powder being obtained, having m. p. 45° (Found : C, 63·9; H, 6·7. $C_{11}H_{13}O_3N$ requires C, 63·7; H, 6·3%).

Monochloroacetyl-α-aldoximes.—The α-aldoxime (5 g.) was dissolved in monochloroacetic anhydride (6·5 g.), heated just above its m. p. (45°), and the solution shaken with excess of 2N-sodium carbonate. The product was collected and crystallised from benzene–light petroleum, giving *monochloroacetyl-α-p-nitrobenzaldoxime* as greenish-white plates, m. p. 131° (Found : C, 44·5; H, 2·8. $C_9H_7O_4N_2Cl$ requires C, 44·5; H, 2·9%), *monochloroacetyl-α-m-nitrobenzaldoxime* as greenish-white needles, m. p. 129° (Found : C, 44·5; H, 2·9%), *monochloroacetyl-α-o-nitrobenzaldoxime* as plates, m. p. 94° (Found : C, 44·6; H, 3·1%), *monochloroacetyl-α-benzaldoxime* from light petroleum as silky needles, m. p. 84° (Found : C, 54·9; H, 4·2. $C_9H_8O_2NCl$ requires C, 54·7; H, 4·1%), *monochloroacetyl-α-p-methoxybenzaldoxime* from light petroleum as plates, m. p. 60° (Found : C, 53·0; H, 4·3. $C_{10}H_{10}O_4NCl$ requires C, 52·8; H, 4·4%), and *monochloroacetyl-α-3 : 4-dimethoxybenzaldoxime* from light petroleum–carbon tetrachloride as needles, m. p. 101° (Found : C, 51·4; H, 4·7. $C_{11}H_{12}O_4NCl$ requires C, 51·3; H, 4·7%).

Trichloroacetyl-α-aldoximes.—α-*p*-Nitrobenzaldoxime (2 g.) was dissolved at 30° in trichloroacetic anhydride (7 g.), poured into excess of 2N-sodium carbonate, and shaken till solid had separated. This was collected at once, dried on porous tile, and crystallised from benzene–light petroleum. *Trichloroacetyl-α-p-nitrobenzaldoxime* crystallised in prisms, m. p. 130°. The trichloroacetyl derivatives are very unstable and cannot be kept for more than a few hours, so for analytical purposes the trichloroacetyl group was at once determined by dissolving the compound in a known excess of 0·2N-sodium hydroxide and back-titrating with 0·2N-hydrochloric acid (methyl-orange) (Found : $C_2HO_2Cl_3$, 52·0. $C_9H_5O_4N_2Cl_3$ requires $C_2HO_2Cl_3$, 52·5%).

In the case of α-*m*-nitrobenzaldoxime the solution in the warm anhydride was decomposed with water, and the precipitate crystallised from light petroleum as colourless needles, m. p. 93—94° (Found : $C_2HO_2Cl_3$, 50·7%).

In the remaining cases the oxime was dissolved in the anhydride at 0° and poured into ice-cold water. *Trichloroacetyl-α-3 : 4-methylenedioxybenzaldoxime* crystallises from carbon tetrachloride in needles, m. p. 93° (Found : $C_2HO_2Cl_3$, 53·2. $C_{10}H_6O_4NCl_3$ requires $C_2HO_2Cl_3$, 52·6%), and *trichloroacetyl-α-3 : 4-dimethoxybenzaldoxime* from carbon tetrachloride–light petroleum as plates, m. p. 92° (Found : $C_2HO_2Cl_3$, 50·9. $C_{11}H_{10}O_4NCl_3$ requires $C_2HO_2Cl_3$, 50·1%). In spite of every precaution the addition of α-benzaldoxime and α-*p*-methoxybenzaldoxime to trichloroacetic anhydride produced a violent reaction and brown oils smelling strongly of the respective nitriles were obtained.

n-*Heptoyl-α-aldoximes.*—The α-aldoxime (5 g.) was heated on a water-bath for 15 minutes with *n*-heptoic anhydride (8 c.c.) and cooled. After 24 hours n-*heptoyl-α-p-nitrobenzaldoxime* crystallised, and after recrystallisation from light petroleum formed pale green soapy plates, m. p. 60° (Found : C, 60·0; H, 6·0. $C_{14}H_{18}O_4N_2$ requires C, 60·4; H, 6·5%). *n*-Heptoyl-α-*m*-nitrobenzaldoxime was precipitated by stirring the solution in the anhydride with 2N-sodium carbonate, and extracting the product with ether and washing it with light petroleum; the product is an oil which on cooling gave a pale green crystalline mass, m. p. 8°.

Acetyl-β-aldoximes.—These were prepared by dissolving the β-aldoxime in the minimum amount of pure acetic anhydride, warming the mixture to $\gtrsim$30°, and then cooling it in a freezing mixture for an hour, filtering off the product, and washing it with light petroleum. The m. p.s of the compounds agreed with those previously published, except that acetyl-β-*p*-nitrobenzaldoxime melted at 105° and after crystallisation from benzene at 106° (Brady and McHugh, *J.*, 1925, **127**, 2414, give 96°).

Acetyl-β-2 : 4-dimethoxybenzaldoxime is prepared by dissolving the oxime in the minimum amount of pure acetic anhydride at 25° and shaking the solution with 2N-sodium carbonate, whereupon

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the acetyl derivative, which is, unlike most other acetyl-β-aldoximes, not readily decomposed by this reagent, separates and crystallises from light petroleum in colourless crystals, m. p. 68—70°.

Propionyl-β-aldoximes.—These were prepared in the same way as the acetyl derivatives: *propionyl-β-p-nitrobenzaldoxime* forms pale yellow needles, m. p. 100° (Found: C, 54·2; H, 4·3. $C_{10}H_{10}O_4N_2$ requires C, 54·0; H, 4·5%), *propionyl-β-3 : 4-methylenedioxybenzaldoxime* forms a microcrystalline powder, m. p. 71° (Found: C, 59·3; H, 4·9. $C_{11}H_{11}O_4N$ requires C, 59·7; H, 5·0%).

Hydrolysis of Acetyl-β-aldoximes.—A weighed quantity of the acetyl derivative (1—2 g.) was added to 2N-sodium hydroxide (30 c.c.), cooled to 0°, and placed in a refrigerator for 45 minutes. At the end of that time decomposition had occurred, and the insoluble nitrile was collected, washed with water, dried, and weighed; it was subsequently identified by a m. p. and mixed m. p. determination. The alkaline solution was treated with a saturated solution of ammonium chloride, and the precipitated oxime collected, washed with a little water, dried, and weighed. No allowance was made for the slight solubility of the oximes in water so the yield of oxime is low. In the cases of acetyl-β-*p*-methyl-, acetyl-β-3 : 4-dimethoxy-, and acetyl-β-2 : 4-dimethoxy-benzaldoximes, as it was difficult to isolate the pure compounds, a weighed amount of the β-oxime was dissolved in the minimum of acetic anhydride at 25° and the solution was added to 150 c.c. of 2N-sodium hydroxide and treated as above. The amount of acetyl compound hydrolysed was calculated on the assumption that all the oxime was acetylated. As a check on this method β-*p*-methoxybenzaldoxime was treated in this way, the nitrile formed being 66·2% as against 66% when acetyl-β-*p*-methoxybenzaldoxime was hydrolysed by the first method.

Hydrolysis of Propionyl-β-aldoximes.—The method was the same as for the hydrolysis of the acetyl compounds, except that the propionyl compounds, owing to their greater stability, had to be kept in contact with the sodium hydroxide for 24 hours to ensure complete decomposition. In the cases of the propionyl derivative of β-*p*-chloro-, β-*p*-methyl-, and β-*p*-methoxy-benzaldoximes a solution of the β-aldoxime in propionic anhydride was hydrolysed, as the pure propionyl derivative could not be isolated.

Hydrolysis of Propionyl-α-aldoximes.—The propionyl derivative (0·5 g.) was treated with 2N-sodium hydroxide (75 c.c.). No appreciable action took place at room temperature in 10 minutes, so the suspension was boiled for 5 minutes, whereupon complete dissolution occurred; on cooling of the solution, no nitrile separated; the oxime was precipitated with saturated ammonium chloride solution, and the filtrate therefrom acidified and extracted with ether. The residue from the ether was examined for carboxylic acid formed by hydrolysis of nitrile, but with negative results in the cases of the propionyl-α-aldoximes described above.

Hydrolysis of Monochloroacetyl-α-aldoximes.—When carried out as above, the hydrolysis of the monochloroacetyl-α-aldoximes described gave only oxime, except in the case of monochloroacetyl-α-*o*-nitrobenzaldoxime where a small quantity of *o*-nitrobenzonitrile separated on cooling.

Hydrolysis of Trichloracetyl-α-aldoximes.—This was carried out in 2N-sodium hydroxide at 0° for 1 hour and the products were isolated as above.

Hydrolysis of n-*Heptoyl-α-aldoximes.*—The compound (1 g.) was boiled for 15 minutes with 2N-sodium hydroxide (10 c.c.), and the solution examined as before, but only the α-aldoxime was detected.

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[*Received, October 7th*, 1949.]