IX.—*The Condensation of α-Keto-β-anilino-α-phenylethane and its Homologues with Carbonyl Chloride, Phenylcarbimide, and Phenylthiocarbimide.*

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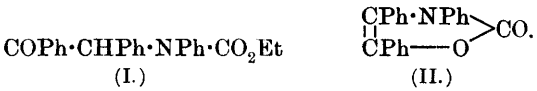
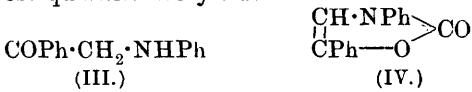
IT has been shown by McCombie and Parkes (T., 1912, **101**, 1991) that dihydro-oxazolones can be obtained from α-keto-β-anilino-αβ-diphenylethane by two methods, namely, (i) the ketone was converted into its carbethoxy-derivative (I), which on treatment with potassium hydroxide in alcoholic solution lost the elements of alcohol with the formation of 3:4:5-triphenyl-2:3-dihydro-2-oxazolone (II); (ii) by the direct action of carbonyl chloride in toluene solution on the keto-compound, in the presence of pyridine, the same dihydro-oxazolone was produced:



(I.) (II.)

Attempts have now been made to extend this reaction to the preparation of dihydro-oxazolones containing one phenyl group less than the compounds described by McCombie and Parkes. The starting point for this work was α-keto-β-anilino-α-phenylethane (III), which is easily prepared from ω-bromoacetophenone by condensation with aniline. Attempts to prepare dihydro-oxazolones from this compound through the carbethoxy-derivative failed, as all attempts to prepare the latter yielded only the unchanged ketone. Success, however, attended the efforts when the second

method of synthesis was employed. α-Keto-β-anilino-α-phenylethane, in the presence of pyridine, when condensed with carbonyl chloride in toluene solution, yielded 3:5-diphenyl-2:3-dihydro-2-oxazolone (IV) in almost quantitative yields:



(III.) (IV.)

By similar condensations the corresponding *o*-, *m*-, and *p*-tolyl and β-naphthyl derivatives were obtained, these substituents being in each case attached to the nitrogen atom. The α-naphthyl derivative could not be prepared, but some of the substance was formed, and floated in the toluene layer, but could not be isolated and recrystallised.

These dihydro-oxazolones are very stable, the presence of the double bond did not lead to the addition of bromine, and the hydrogen atom in position 4 could not be substituted by bromine. The basicity of these compounds is so slight that no hydrochloride or picrate could be isolated.

Compounds similar to the sulphinazoles described by McCombie and Parkes (*loc. cit.*) might have been expected to arise from these ketones by condensation with thionyl chloride instead of carbonyl chloride. With α-keto-β-anilino-α-phenylethane and thionyl chloride, however, no change took place, the compound being recovered unchanged. With the analogous *p*-toluidine and β-naphthyl compounds a black, tarry mass was obtained, from which no crystalline product could be isolated; thus, thionyl chloride appears incapable of forming ring compounds with this series of ketones.

Brazier and McCombie (T., 1912, **101**, 2352) have shown that α-keto-β-anilino-αβ-diphenylethane and its homologues can be converted into ring compounds of the type 1:3:4:5-tetraphenyl-2:3-dihydro-2-glyoxalone (V) by condensation with phenylcarbimide. This synthesis has now been extended to include a series of dihydroglyoxalones having one phenyl group less.

Thus when phenylcarbimide was condensed with α-keto-β-anilino-α-phenylethane (III) there resulted 1:3:4-triphenyl-2:3-dihydro-2-glyoxalone (VI):

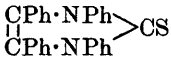
(V.) (VI.)

By similar condensations the homologous tolyl and β-naphthyl derivatives were obtained. The α-naphthyl derivative could not be isolated; an olive-green mass was formed, which could not be recrystallised.

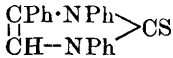
These glyoxalones are stable compounds, and their basicity is of such an order as to give rise to picrates but no hydrochlorides. *o*-Tolylglyoxalone did not form a picrate which could be isolated, but the evidence seems to show that one is formed in hot glacial acetic acid solution.

Brazier and McCombie (*loc. cit.*) found that two series of picrates were formed by the glyoxalones which they described, the series depending on the group attached to the nitrogen atom in position 3, and that the colour varied with the composition. Only one series of picrates was formed with these new glyoxalones, in which one molecule of the acid was combined with one molecule of the base, and the colours of the picrates varied between deep orange and red.

It has been shown by Brazier and McCombie (*loc. cit.*) that phenylthiocarbimide condenses with α-keto-β-anilino-αβ-diphenylethane to give 1:3:4:5-tetraphenyl-2:3-dihydro-2-glyoxalthione (VII). This condensation has been extended so as to give a series of dihydroglyoxalthiones containing one phenyl group less; thus, when phenylthiocarbimide reacted with α-keto-β-anilino-α-phenylethane we obtained 1:3:4-triphenyl-2:3-dihydro-2-glyoxalthione (VIII):



(VII.)



(VIII.)

By a similar series of condensations, the analogous *o*-, *m*-, and *p*-tolyl compounds were obtained. The α- and β-naphthyl compounds could not be isolated, as all attempts at crystallisation of the α-naphthyl derivative resulted in a viscid, syrupy liquid, and the β-naphthyl derivative gave a white, crystalline substance melting at 166—167°, and having a nitrogen content of 7·30 per cent.

Experimental.

3:5-*Diphenyl*-2:3-*dihydro*-2-*oxazolone* (IV).

This compound was prepared by dissolving 2·1 grams of α-keto-β-anilino-α-phenylethane in 10 grams of pyridine, and adding 10 grams of a toluene solution of carbonyl chloride (20 per cent.). The mixture was cooled in ice, and, after eighteen hours, was poured into dilute hydrochloric acid to remove the pyridine. The oxazolone was precipitated in the toluene layer as a brown, flocculent mass, which was separated by filtration, decolorised by boiling with animal charcoal, and recrystallised three times from toluene, when it melted at 167—168°. The yield was nearly theoretical:

0·1500 gave 0·4180 CO_2 and 0·0627 H_2O. C = 76·00; H = 4·65.
0·1500 „ 7·9 c.c. N_2 at 15·5° and 725·3 mm. N = 5·83.
$C_{15}H_{11}O_2N$ requires C = 75·97; H = 4·64; N = 5·91 per cent.

3 : 5-*Diphenyl*-2 : 3-*dihydro*-2-*oxazolone* crystallises in white, glistening needles, which are soluble in glacial acetic acid or alcohol in the cold, and moderately so in most organic solvents on warming.

No salt with picric acid could be prepared in glacial acetic acid solution, or by fusing with the acid alone. Bromination of the compound in chloroform solution could not be effected. No hydrochloride could be isolated in an alcoholic or a glacial acetic acid solution.

5-*Phenyl*-3-o-*tolyl*-2 : 3-*dihydro*-2-*oxazolone*, $C_{16}H_{13}O_2N$.

This compound was prepared in the same manner, except that it was allowed to remain for three days before the condensation was complete. The yield was 60 per cent. of that required by theory, and the substance melted at 124—125°:

0·2000 gave 0·5602 CO_2 and 0·0937 H_2O. C = 76·4; H = 5·20.
0·2000 „ 9·95 c.c. N_2 at 21° and 752 mm. N = 5·57.
$C_{16}H_{13}O_2N$ requires C = 76·4; H = 5·18; N = 5·58 per cent.

α-*Keto*-β-m-*toluidino*-α-*phenylethane*, $C_{15}H_{15}ON$.

This substance was prepared by dissolving 10 grams of ω-bromoacetophenone in 40 grams of alcohol, and then adding 11 grams of *m*-toluidine. After remaining at room temperature for thirty minutes, the liquid changed to a yellow, almost solid mass. This solid was separated and recrystallised three times from alcohol, when it melted at 113—114°. The compound crystallises in small, lemon-yellow needles, which are soluble in all common organic solvents. The yield was theoretical:

0·2000 gave 0·5866 CO_2 and 0·1216 H_2O. C = 79·99; H = 6·70.
$C_{15}H_{15}ON$ requires C = 80·0; H = 6·66 per cent.

The analogous aniline and *o*-toluidine compounds have been prepared by Bischler (*Ber.*, 1892, **25**, 2860), the α- and β-naphthylamine derivatives by Kunckell (*Ber.*, 1897, **30**, 575), and the *p*-toluidine compound by Lellmann and Donner (*Ber.*, 1890, **23**, 167). They were prepared more easily by the authors in the manner described for α-keto-β-*m*-toluidino-α-phenylethane.

5-*Phenyl*-3-m-*tolyl*-2 : 3-*dihydro*-2-*oxazolone*, $C_{16}H_{13}O_2N$.

This oxazolone is soluble to a greater extent in toluene, and an increased yield is obtained by evaporating, in a brisk draught,

the toluene layer which is formed on pouring the condensation mixture into dilute acid. The crystals are needle-shaped, and unite to form clotted masses, which melt at 84—85°:

The yield was 60 per cent. of the theoretical:

0·2000 gave 0·5594 CO_2 and 0·0950 H_2O. C=76·29; H=5·27.
$C_{16}H_{13}O_2N$ requires C=76·40; H=5·18 per cent.

5-*Phenyl*-3-p-*tolyl*-2:3-*dihydro*-2-*oxazolone*, $C_{16}H_{13}O_2N$.

This compound crystallises from toluene in long needles, which unite to form clotted masses, and melts at 173—174°:

0·2000 gave 0·5608 CO_2 and 0·0950 H_2O. C=76·43; H=5·27.
0·2000 „ 10·05 c.c. N_2 at 21·5° and 748 mm. N=5·59.
$C_{16}H_{13}O_2N$ requires C=76·40; H=5·18; N=5·58 per cent.

5-*Phenyl*-3-β-*naphthyl*-2:3-*dihydro*-2-*oxazolone*, $C_{19}H_{13}O_2N$.

This compound crystallises from toluene in shining needles melting at 193—194°:

0·2000 gave 0·5870 CO_2 and 0·0822. C=80·04; H=4·57.
0·2000 „ 8·85 c.c. N_2 at 16° and 739·5 mm. N=4·92.
$C_{19}H_{13}O_2N$ requires C=80·00; H=4·53; N=4·88 per cent.

1:3:4-*Triphenyl*-2:3-*dihydro*-2-*glyoxalone* (VI).

This compound is prepared by heating on a water-bath for three hours a mixture of α-keto-β-anilino-α-phenylethane (2·1 grams) and phenylcarbimide (1·5 grams). A clear solution is first formed, which gradually solidifies. On further heating water is eliminated and a white mass obtained. This mass is dissolved in alcohol, and 1 c.c. of concentrated hydrochloric acid is added, and the solution heated under reflux for three hours. On cooling, the glyoxalone separates in clotted, white masses, which after five recrystallisations melted at 164—165° The substance can be equally well recrystallised from toluene, and is soluble on warming in all common organic solvents. The yield was 2·5 grams:

0·2010 gave 0·5958 CO_2 and 0·0936 H_2O. C=80·84; H=5·17.
0·1518 „ 12·5 c.c. N_2 at 21° and 735 mm. N=9·01.
$C_{21}H_{16}ON_2$ requires C=80·76; H=5·12; N=8·97 per cent.

The *picrate* was prepared in a boiling acetic acid solution, from which it crystallises in deep crimson needles melting at 130—131°. This salt is readily decomposed by boiling with water, alcohol, or alkali, with regeneration of the glyoxalone:

0·2094 gave 0·4594 CO_2 and 0·0676 H_2O. C=59·84; H=3·58.
$C_{21}H_{16}ON_2,C_6H_3O_7N_3$ requires C=59·88; H=3·51 per cent.

3 : 4-*Diphenyl*-1-o-*tolyl*-2 : 3-*dihydro*-2-*glyoxalone*, $C_{22}H_{18}ON_2$.

This compound crystallises from alcohol in small, glistening needles, which melt at 159—160°:

0·2099 gave 0·6251 CO_2 and 0·1066 H_2O. C = 81·15; H = 5·64.
$C_{22}H_{18}ON_2$ requires C = 80·98; H = 5·52 per cent.

No picrate of this glyoxalone could be isolated, either by fusing with picric acid or by boiling with picric acid in acetic acid solution, although the mixture assumed a deep red colour, similar to that exhibited by the other glyoxalones.

3 : 4-*Diphenyl*-1-m-*tolyl*-2 : 3-*dihydro*-2-*glyoxalone*, $C_{22}H_{18}ON_2$.

This substance crystallises from alcohol in fine, white needles, which unite to form clotted masses, and melt at 135—136°:

0·2152 gave 0·6384 CO_2 and 0·1101 H_2O. C = 80·90; H = 5·68.
$C_{22}H_{18}ON_2$ requires C = 80·98; H = 5·52 per cent.

The *picrate* crystallises from glacial acetic acid in deep scarlet, glistening needles, which melt at 126—127°:

0·2061 gave 0·4563 CO_2 and 0·0747 H_2O. C = 60·39; H = 4·02.
$C_{22}H_{18}ON_2,C_6H_3O_7N_3$ requires C = 60·53; H = 4·02 per cent.

3 : 4-*Diphenyl*-1-p-*tolyl*-2 : 3-*dihydro*-2-*glyoxalone*, $C_{22}H_{12}ON_2$.

This substance crystallises from alcohol in fine, small needles, which melt at 165—166°:

0·2000 gave 0·5924 CO_2 and 0·1018 H_2O. C = 80·78; H = 5·65.
0·3000 „ 23·4 c.c. N_2 at 22° and 748·5 mm. N = 8·65.
$C_{22}H_{18}ON_2$ requires C = 80·98; H = 5·52; N = 8·59 per cent.

The *picrate* separates from glacial acetic acid in deep red, glistening needles, which melt at 136—137°:

0·2086 gave 0·4638 CO_2 and 0·0729 H_2O. C = 60·61; H = 3·88.
$C_{22}H_{18}ON_2,C_6H_3O_7N_3$ requires C = 60·53; H = 3·78 per cent.

Phenyl-β-naphthylbenzoylmethylcarbamide,
$CH_2Bz{\cdot}N(C_{10}H_7){\cdot}CO{\cdot}NHPh$.

If a mixture of α-keto-β-2-naphthylamino-α-phenylethane (2·6 grams) and phenylcarbimide (1·5 grams) is heated very gently on a water-bath, a white product is obtained. This is kept for a short time in contact with alcohol, and is then recrystallised from toluene, when it melts at 167—168°:

0·1390 gave 0·4026 CO_2 and 0·0652 H_2O. C = 78·97; H = 5·21.
$C_{25}H_{20}O_2N_2$ requires C = 78·93; H = 5·26 per cent.

This compound, on boiling with alcohol, loses water, and is converted into the glyoxalone.

3:4-*Diphenyl*-1-*β*-*naphthyl*-2:3-*dihydro*-2-*glyoxalone*, $C_{25}H_{18}ON_2$.

This substance crystallises from alcohol or toluene in glistening needles, which melt at 175—176°:

0·2000 gave 0·6074 CO_2 and 0·0903 H_2O. C = 82·83; H = 5·02.
$C_{25}H_{18}ON_2$ requires C = 82·87; H = 4·97 per cent.

The *picrate* crystallises from glacial acetic acid in orange-brown needles, which melt at 167—168°:

0·2002 gave 0·4620 CO_2 and 0·0664 H_2O. C = 62·96; H = 3·70.
$C_{25}H_{18}ON_2,C_6H_3O_7N_3$ requires C = 62·93; H = 3·53 per cent.

1:3:4-*Triphenyl*-2:3-*dihydro*-2-*glyoxalthione* (VIII).

This substance was prepared by heating 2·1 grams of *α*-keto-*β*-anilino-*α*-phenylethane and 1·7 grams of phenylthiocarbimide in an oil-bath at 130—140° for three to four hours. The product was then crystallised from toluene, when it separated in small, glistening needles, melting at 170—171°. The needles are not quite white even after seven recrystallisations, but have a slight yellow tinge. The compound can be recrystallised from alcohol, and is soluble in most organic solvents. The yield is about 30—40 per cent. of the theoretical:

0·2066 gave 0·5810 CO_2 and 0·0893 H_2O. C = 76·70; H = 4·80.
0·1525 „ 11·6 c.c. N_2 at 15° and 744·3 mm. N = 8·68.
0·2817 „ 0·2019 $BaSO_4$. S = 9·84.
$C_{21}H_{16}N_2S$ requires C = 76·82; H = 4·87; N = 8·57; S = 9·75 per cent.

3:4-*Diphenyl*-1-o-*tolyl*-2:3-*dihydro*-2-*glyoxalthione*, $C_{22}H_{18}N_2S$.

This compound crystallises from toluene in small, glistening needles, melting at 165—166°:

0·1650 gave 0·4680 CO_2 and 0·0786 H_2O. C = 77·33; H = 5·29.
$C_{22}H_{18}N_2S$ requires C = 77·20; H = 5·29 per cent.

3:4-*Diphenyl*-1-m-*tolyl*-2:3-*dihydro*-2-*glyoxalthione*, $C_{22}H_{18}N_2S$.

This substance crystallises from toluene in small, white needles, melting at 168—169°:

0·1738 gave 0·4920 CO_2 and 0·0836 H_2O. C = 77·29; H = 5·3.
$C_{22}H_{18}N_2S$ requires C = 77·20; H = 5·26 per cent.

3 : 4-*Diphenyl*-1-p-*tolyl*-2 : 3-*dihydro*-2-*glyoxalthione*, $C_{22}H_{18}N_2S$.

When recrystallised from toluene, this substance separates in long, white needles, which unite to form clotted masses melting at 192—193°:

0·1533 gave 0·4355 CO_2 and 0·0710 H_2O. C = 77·46; H = 5·15.
$C_{22}H_{18}N_2S$ requires C = 77·20; H = 5·26 per cent.

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