

CHAPTER - IV

Reactions of diazo ketones with some olefinic systems.

Section-A : Aims and Objects

In the previous chapter we have studied the reactions of different diazo ketones with cinnamic esters largely. In this chapter a comparative study regarding the reactivity of keto carbene with some olefins is recorded. Our ~~want~~ aim of examination is to isolate the amount of cyclopropane derivatives after reaction according to the procedure adopted earlier.

For the study we selected methyl methacrylate and methyl crotonate to see the effect of methyl group in the position of the methyl acrylate towards keto carbene addition. We have taken cyclohexene and α -methyl 3,4 dihydronaphthalene to see their reactivity towards keto carbene. Reaction of cyclohexene with α -diazo acetophenone and diazo methyl naphthyl ketone have been studied to account for the reactivity of keto carbene towards the same olefin.

Reactions of diazo cyclohexyl ketone with o-methoxy methyl cinnamate and 2-diazo cyclohexanone with α -methyl 3,4 dihydronaphthalene have been studied to see their reactivity.

The structure of the cyclopropyl ketones were confirmed by elemental analysis, I.R. and G.L.C and N.M.R in one case.

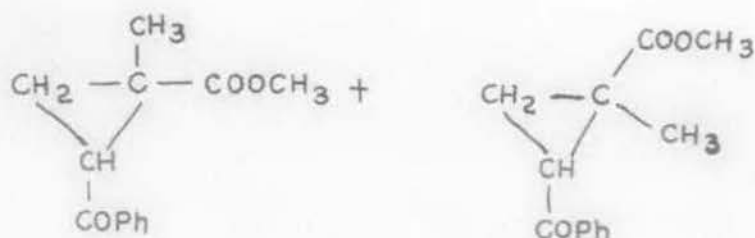
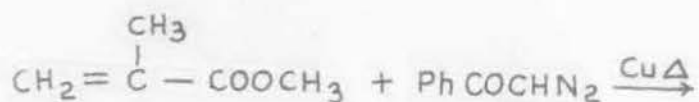
Section-B: Results and Discussions.

Reactions of α -dialzo acetophenone with methyl methacrylate.

The copper catalysed decomposition of α -dialzo acetophenone was carried out in a large excess of methyl methacrylate. Exothermic reaction occurred and evolution of nitrogen observed. The reaction product was separated into two fractions by vacuum distillation.

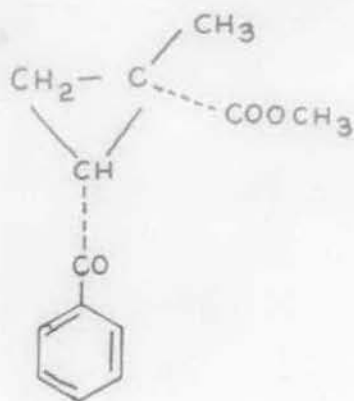
By means of elemental analysis, I.R., G.L.C and N.M.R. spectra, the lower boiling fraction was confirmed to be a mixture of cis and trans-1-benzoyl-2-carbomethoxy-2-methyl cyclopropane, the addition products of benzoyl carbene to methyl methacrylate. G.L.C showed two peaks with different retention time. I.R. at 1735 cm^{-1} , 1670 cm^{-1} , 1010 cm^{-1} indicated that the compound contain one ester, carbonyl group and a cyclopropane ring.

The higher boiling fraction was identified as 1,2, dibenzoyl ethylene. The structure of this compound was confirmed by the comparison of melting points and I.R. spectra with those of the authentic samples prepared according to known methods as well as those isolated earlier.

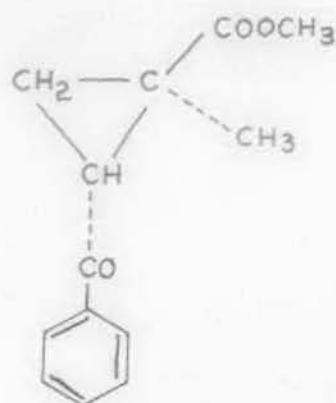


N.M.R spectrum of the reaction product of methyl methacrylate and α -diazo acetophenone.

G.L.C of the reaction products of methyl methacrylate and α -diazo acetophenone shows a mixture of two products. This is also confirmed by the observation of their N.M.R spectra. One component is confirmed as cis-1-benzoyl-2-carbomethoxy-2-methyl cyclopropane and another as trans isomer.



Cisform



Transform

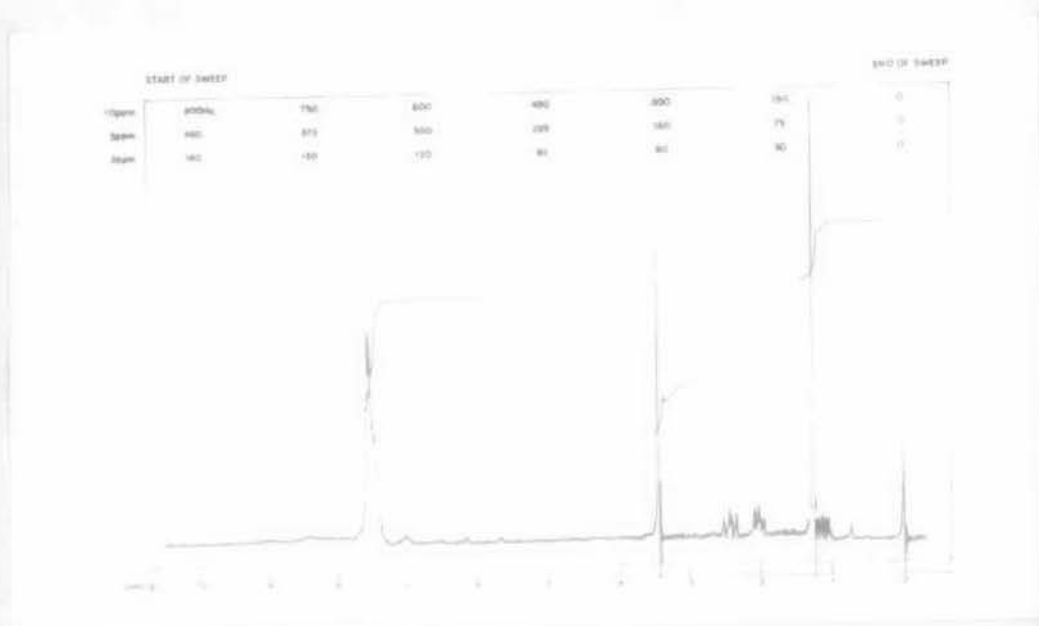


Fig. P.10. N.M.R. spectrum of cis form of the reaction product of methyl methacrylate and -diazacetophenone.

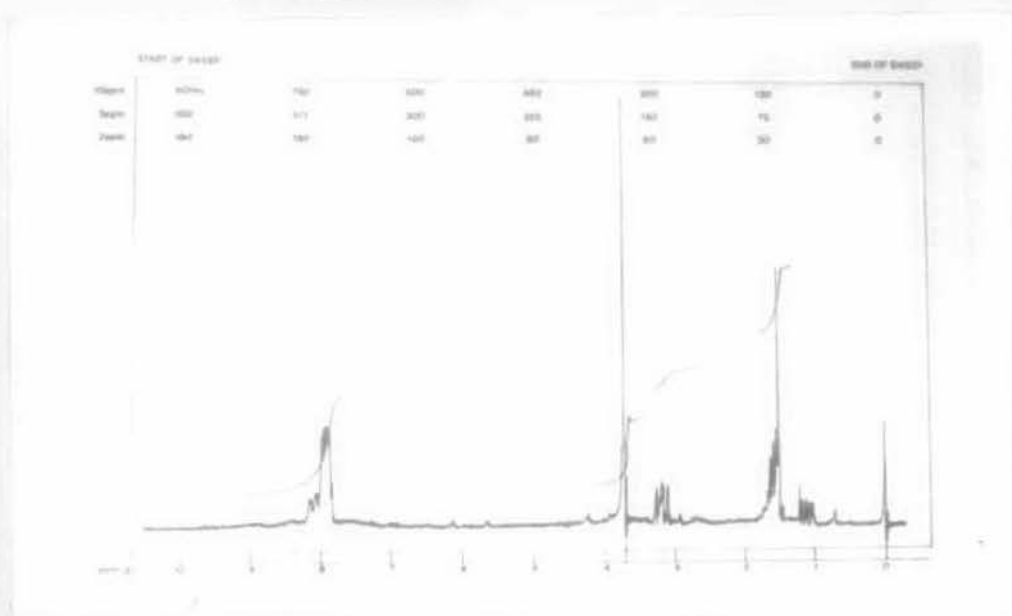


Fig. P.11. N.M.R. spectrum of trans form of the reaction product of methyl methacrylate and -diazacetophenone.

N.M.R signals in CCl_4 of the cis form are as follows.

Fig. P.10

δ 2.43 (H_a), δ 2.00 (H_b), δ 1.2 (CH_3), δ 3.5 (CH_3 of carbomethoxy group) and δ 7.5 (aromatic proton of benzoyl group). This results are consistent with structure of the cis form shown above.

N.M.R signals in CCl_4 of the trans form are as follows. (Fig. P.11) δ 3.2 (H_a), δ 1.7 (H_b), δ 1.52 (CH_3), δ 3.75 (CH_3 of carbomethoxy group) and δ 7.9 (aromatic proton of benzoyl group). This results are consistent with the structure of trans form.

It is also observed that a singlet signal of carbomethoxy proton of the cis form appears at higher field than that of trans form. In addition it may be mentioned here that there is no signal in the region of the olefinic proton which definitely indicates that the reaction products are not contaminated with the starting olefin.

Reaction of α -diazacetophenone with methyl crotonate.

Copper catalysed decomposition of α -diazacetophenone was carried out in a refluxing benzene solution of methyl crotonate. After usual work up of the reaction mixture, two products were separated by fractional crystallisation. One of these two products was 1-benzoyl, 2-carbomethoxy-2'-methyl cyclopropane and another was trans 1, 2, dibenzoyl ethylene.

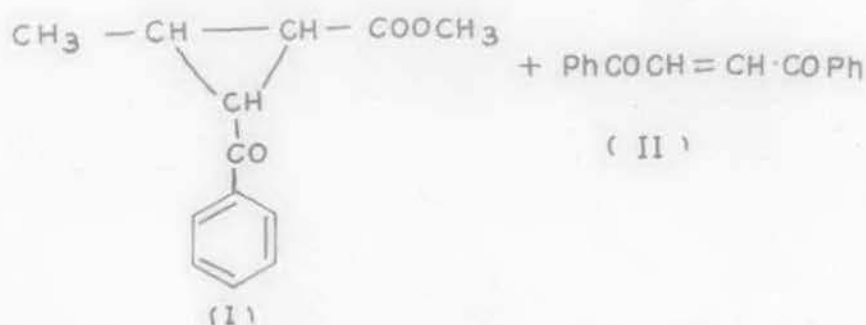
In this case the yield of the cyclopropane derivative was considerably poor.

By means of elemental analysis, I.R., U.V., the structure of (1) was confirmed.

I.R. bands at 1710 cm^{-1} , 1660 cm^{-1} and 1010 cm^{-1} indicated that the compound contained ester and carbonyl group together with a cyclopropane ring.

λ_{max} at 280 nm indicate that there was no phenyl conjugation to the cyclopropane ring.

The structure of (II) was confirmed by the comparison of m.p. and I.R. spectra with those of the authentic sample as earlier.

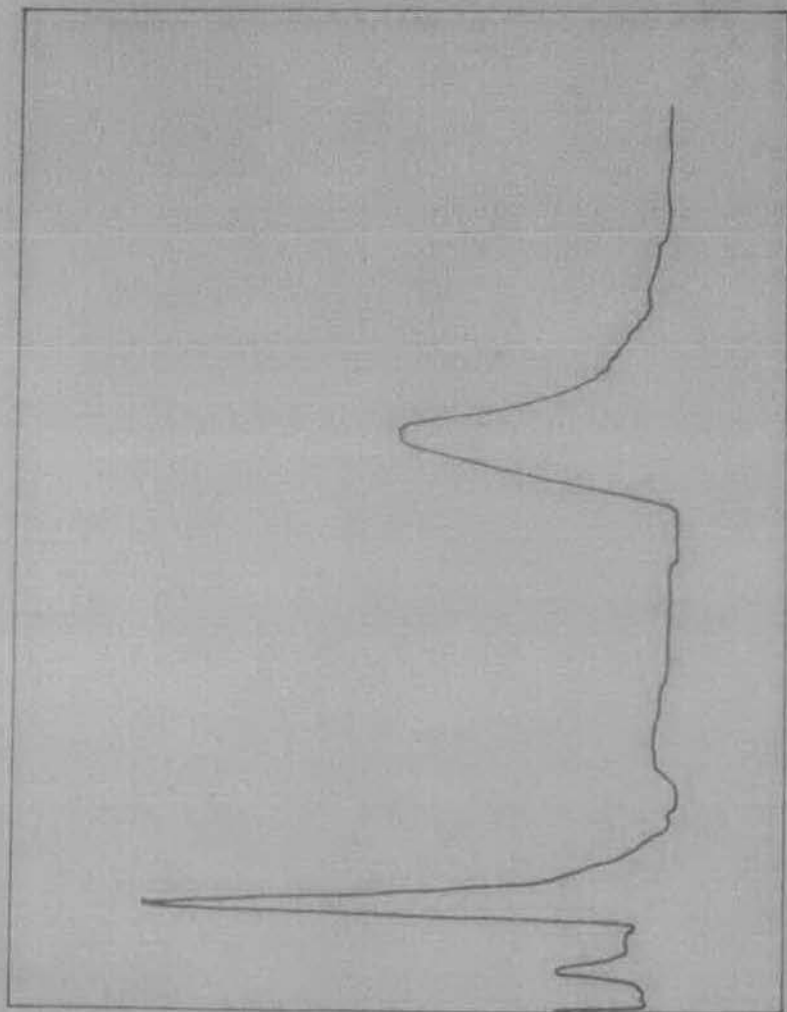


Reaction of α -dialzo acetophenone with cyclohexene.

The reaction of α -dialzo acetophenone with cyclohexene in the presence of copper solution and $\text{Cu}(\text{acac})_2$ to give 7-benzoyl norcarane was reported by Cowan et al and Matsuji Takebayashi et al (111).

Product was found to be a mixture of syn and anti isomers by elemental analysis, melting point test and I.R. absorption spectra of their 2,4-dinitro phenyl hydrazones. G.L.C. shows two peaks for this product.

We also studied the copper catalysed decomposition of α -dialzo acetophenone carried out in a refluxing benzene solution of cyclohexene. After usual work up of the reaction mixture, the product was separated by fractional distillation into its constituents.



Oven temp. 170°C
Injector temp. 230°C
Detector temp. 250°C

G.L.C. of

Fig- 63.

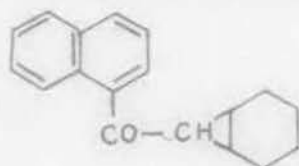
Reaction of α -diazomethyl naphthyl ketone with cyclohexene.

Copper catalysed decomposition of diazo compound was carried out in a refluxing benzene solution of cyclohexene. After usual workup of the reaction mixture, the main product i.e. cyclopropane derivative of cyclohexene was separated by fractional distillation.

The structure of this product was confirmed by elemental analysis, and I.R.

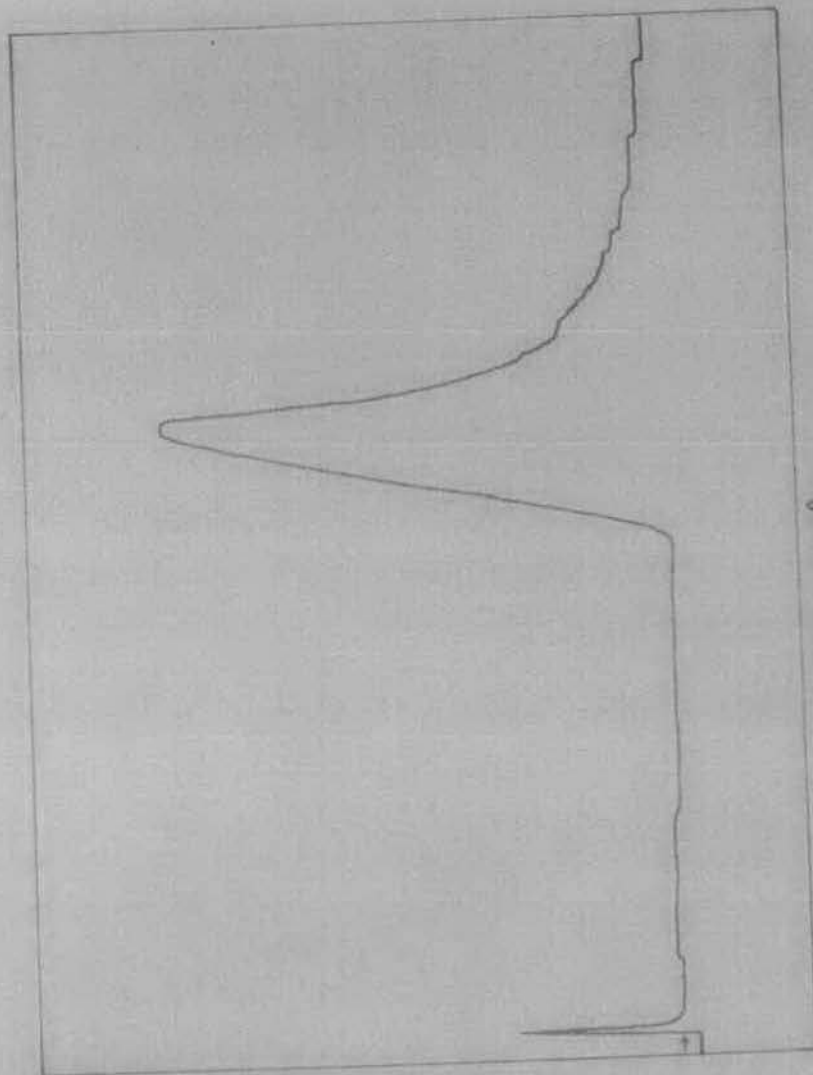
I.R. peaks at 1680 cm^{-1} , 1010 cm^{-1} indicated that the compound contained a carbonyl group and a cyclopropane derivative.

G.L.C. showed two peaks which indicated that syn and anti both the isomers were formed. Fig. 63.



Reaction of diazomethyl cyclohexyl ketone with o-methoxy cinnamic ester (methyl).

Copper catalysed decomposition of diazomethyl cyclohexyl ketone was carried out in a refluxing solution of o-methoxy cinnamic ester (methyl). After usual work up of the reaction mixture, attempt was made to separate the constituents by fractional distillation but was not successful. 2:4 dinitro phenyl hydrazone derivative prepared from the product and this

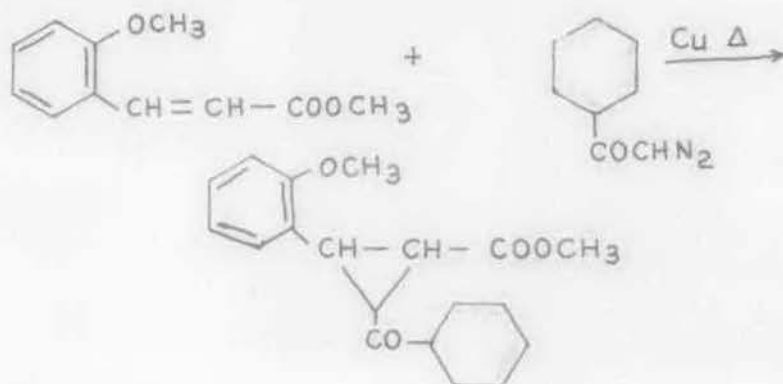


Oven temp. 170°C.
Injector temp. 230°C
Detector temp. 250°C

Fig- 61. G.L.C. of

derivative was crystallised. Elemental analysis is in good agreement with the structure of 1-cyclohexyl-carbonyl-2-carbomethoxy-2' (o-methoxy) phenyl cyclopropane.

I.R. bands of the reaction mixture was taken and it was seen that there was a band at 1010 cm^{-1} which showed that the compound contains one cyclopropane ring. G.L.C. of the product showed only one peak.



Reaction of α -dialzo acetophenone with α -methyl 3,4 dihydro naphthalene.

Copper catalysed decomposition of α -dialzo acetophenone was carried out in a benzene refluxing solution of α -methyl dihydro naphthalene. After usual work up of the reaction mixture, the liquid product was separated by fractional distillation which was found to be the starting olefin. Residue in the distilling flask on crystallisation gave product which was identified as trans 1,2 dibenzoyl ethylene by means of m.p. and I.R. comparison of those of the authentic sample.

In this case, no keto carbene addition product was formed as the olefinic double bond is trisubstituted and the methyl group which sterically inhibits the approach of the keto carbene to the double bond.

It may be noted that the reactivity of these olefins towards keto carbenes is not large in comparison to the reactivity of the cinnamic ester type compounds (which had been studied).

So it is to be concluded that though cinnamic ester type olefins contain a phenyl moiety attached to the double bond does not affect untowardly the reactivity of the keto carbenes.

Inspection of the table 3, it is seen that methyl methacrylate is more reactive than methyl crotonate. So it may be concluded that olefinic ester unsubstituted in the position will give more cyclopropane derivatives than substituted olefinic esters.

Inspection of the table 4, it is observed that cyclohexene gives ketocarbene addition product whereas α -methyl 3,4-dihydro naphthalene does not react at all under the conditions adopted. The reason probably is that in the latter case the olefinic double bond is trisubstituted which prohibits the formation of any cyclopropane derivative easily under the reaction conditions.

But one interesting observation that stands out is that though cyclohexene does not contain any electron withdrawing or donating group attached to its double bond gives rise to lesser amount of cyclopropane derivatives to that of cyclopropane derivatives recovered in the case of o-methoxy methyl cinnamate and p-methoxy methyl cinnamate. So the reactivity of these two esters perhaps is increased due to the presence of methoxy group in the ortho or para positions.

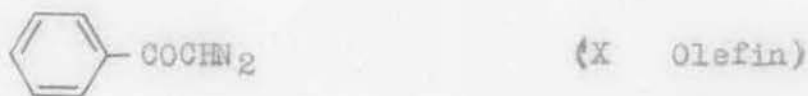
In table 5, is recorded the reactions of aliphatic diazoketones with cinnamic ester type olefins and aromatic diazoketones with cyclohexene. In the two cases a poor yield of addition compound noted. But one thing that is clear is that the reaction between α -methyl 3,4 dihydronaphthalene and 2-diazo cyclohexanone does not give any cyclopropane derivatives. A trisubstituted double bond adjoining the aromatic ring is considerably less reactive towards the ketocarbenes. This unreactivity somewhat parallels the unreactivity of α -tetralones, acenaphthenone to cyanohydrins formation by the usual routes. Thus steric as well as electronic factors govern the reactivity in the reactions recorded here.

Table - 3




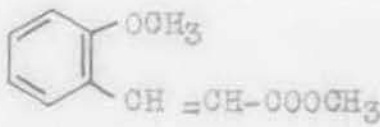
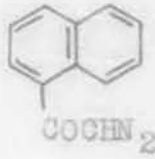

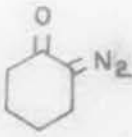
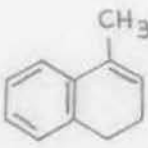
Sl. No.	R ₁	R ₂	Products	
			Addition Product	Self condensation
1.	H	CH ₃	Cis/trans addition 42%	7%
2.	CH ₃	H	15%	10%

Table - 4



Sl. No.	X	Product	
		Addition product	Self condensation
1.	Cyclohexene	27%	8%
2.	α-Methyl 3,4 dihydro naphthalene	-	15%

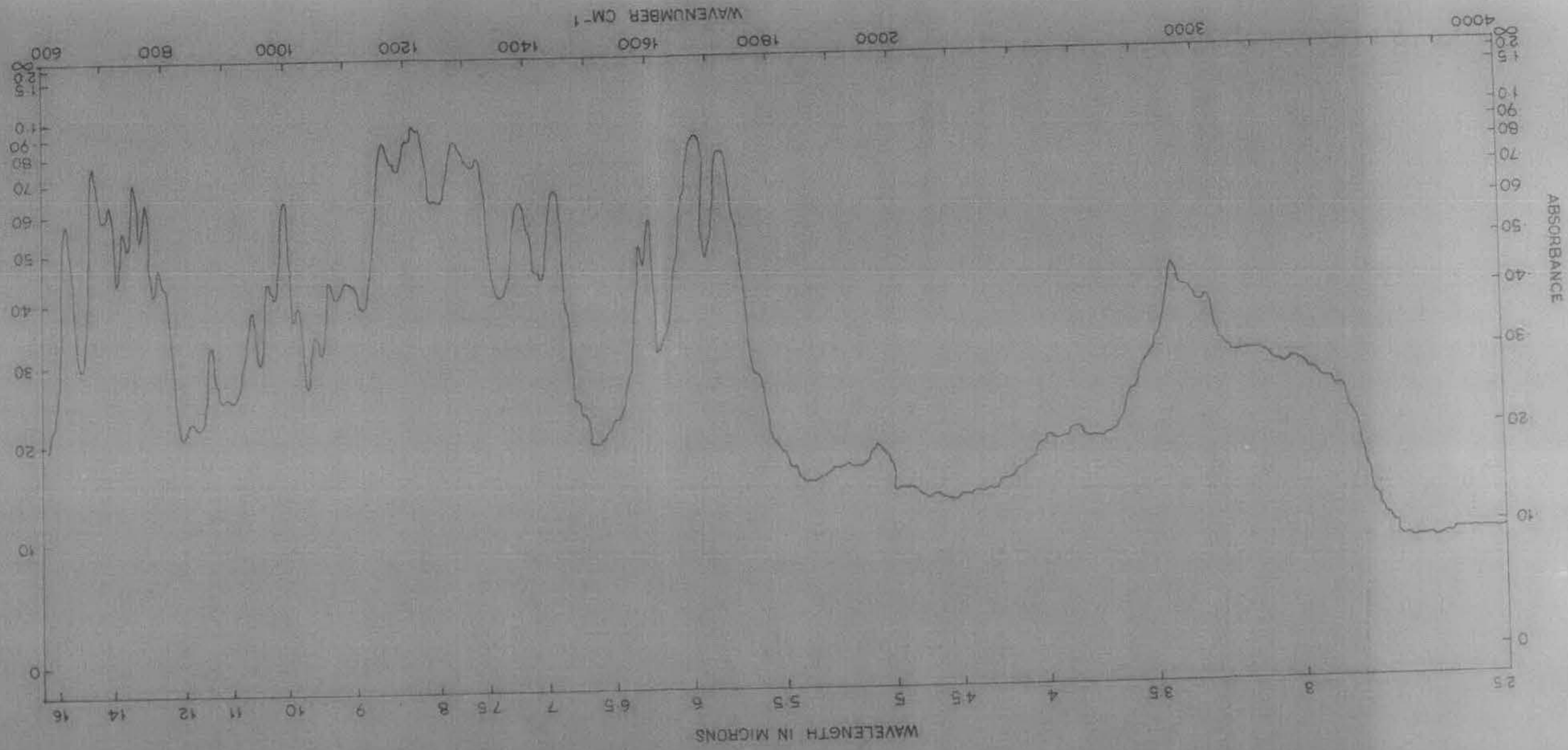
Table - 5

Sl. No.	Y (Diazo ketone)		X (Olefin)	Product	
	Y	X		Addition product	Self condensation
1.			25%	--	
2.			20%	--	
3.			--	--	

Section-C : Experimental

Melting points and boiling points are uncorrected. Dry solvents were used where necessary. The I.R. spectra were recorded in a Beckmann IR-20 Spectrophotometer. UV absorption spectrum were taken in a Beckmann DU-2 Spectrophotometer. N.M.R spectrum was determined on a spectrophotometer using chloroform -d solution. Containing tetramethyl silane as

Fig- 38
1-benzoyl-2-carbomethoxy-2-methyl cyclopropane



internal reference. G.L.C. were taken in Chemical Laboratory, Poona.

1. Reaction^{OF} α -diazacetophenone with methylmethacrylate:

A solution of 5 gm of α -diazacetophenone and 0.1 gm of copper powder in 100 ml of methylmethacrylate was warmed gradually under an atmosphere of nitrogen. The evolution of nitrogen was observed at 60°C and then the temperature rose. After two hours when there was no evolution of nitrogen, the excess methyl methacrylate was removed by ordinary distillation. Then the reaction mixture was treated with 200 ml of methanol to remove the polymer of methyl methacrylate. It was filtered and methanol was removed completely. The residue was distilled under reduced pressure b.p. 135°C/2.5 mm. The wt. of the product-2 gm.

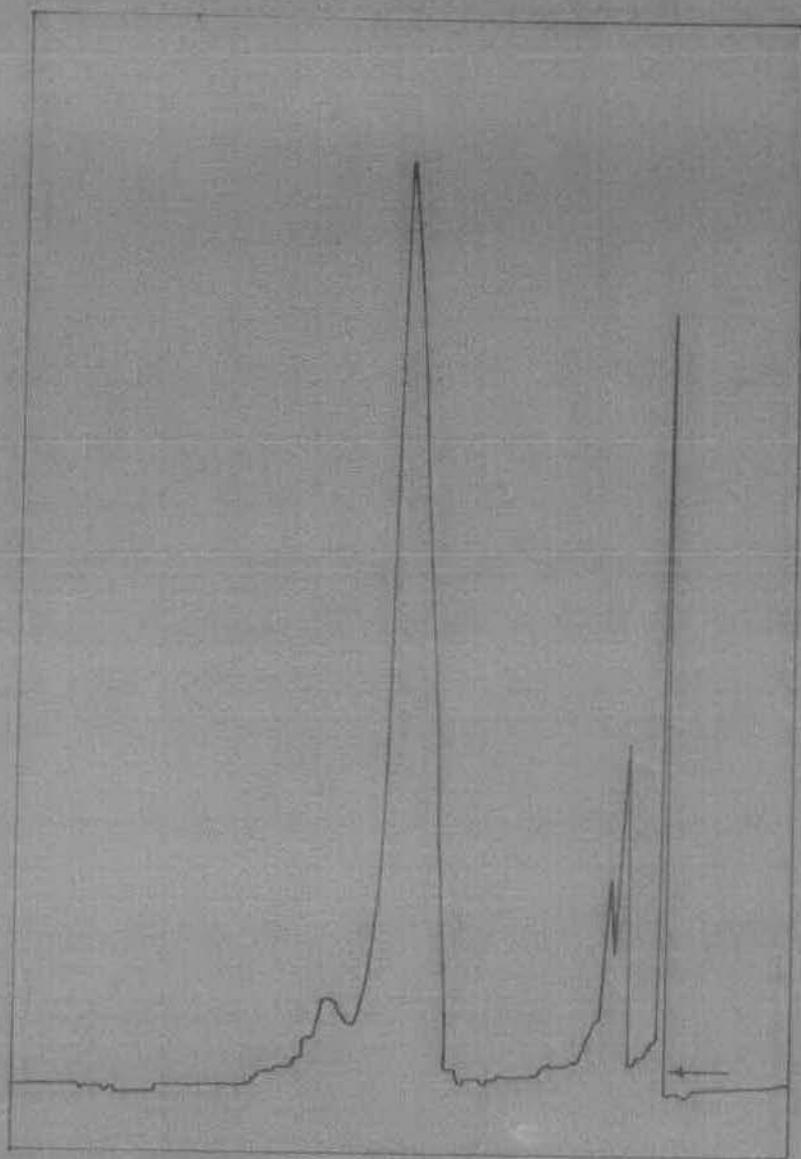
Analysis found: C, 71.13%; H, 6.1%

Calculated for $C_{13}H_{14}O_3$: C, 71.62%; H, 6.47%

I.R. (neat) Fig. 38.

The G.L.C of this fraction showed two peaks ... Fig. 60.

The residue in the flask on fractional crystallisation from light petroleum (60-80°C) gave a yellow crystal. The yellow compound of melting point 110°C was identified as trans 1,2 dibenzoyl ethylene in good agreement with I.R. spectrum and

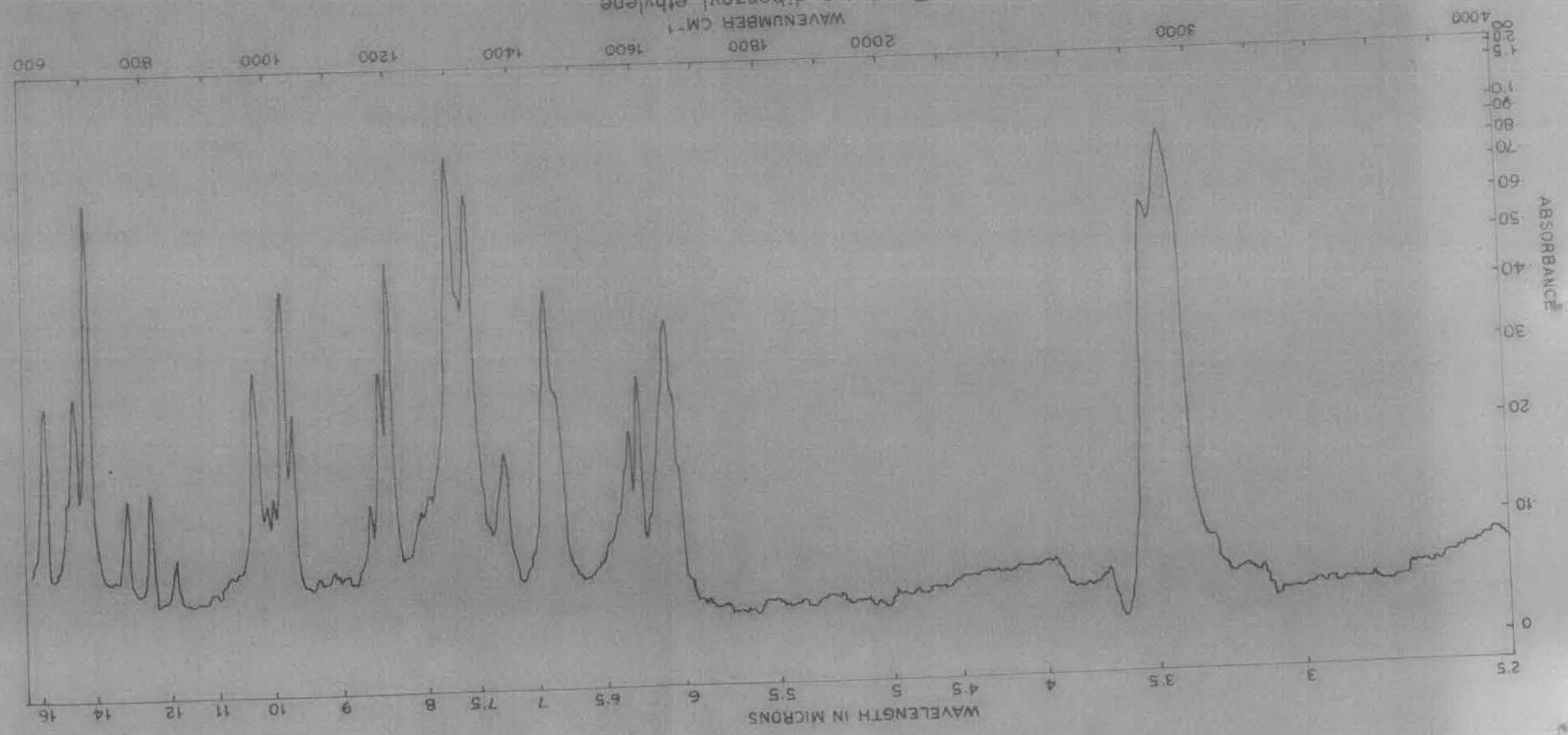


Oven temp. 190°C
Thermal Conductivity Detector.

G.L.C. of

Fig- 60.

Fig- 40. Trans 1,2 dibenzoyl ethylene



the m.p. with the authentic sample (Fig. 40) prepared by the copper bronze catalysed decomposition of α -diazo acetophenone.

2. Reaction between α -diazo cyclohexanone and α -methyl 3,4 dihydronaphthalene.

To a benzene solution of 7.2 gm (0.05 mole) of α -methyl 3,4 dihydronaphthalene was added dropwise a benzene solution of 9.3 gm (0.075 mole) of α -diazo cyclohexanone in presence of 0.1 gm active copper powder. The solution was refluxed for 6 hrs. The reaction mixture was cooled to room temperature added copper was filtered out. Benzene was removed completely and the liquid residue was treated with 200 ml of ether and washed first with 5% sodium bicarbonate solution and then with water until the washing became neutral to pH paper. Ethereal solution was dried over anhydrous sodium sulphate and filtered. Ether was removed completely. The liquid residue was distilled at $124^{\circ}/12\text{mm}$. Yield-6 gm.

I.R. of this product is the same as that of α -methyl 3,4 dihydronaphthalene.

From the residue in the distilling flask attempt was made to isolate any product formed, but no identifiable product could be separated in any amount.

Similar reactions of 2-diazo cyclohexanone with trans-o-methoxy methyl cinnamate, or trans-o-nitro methyl cinnamate also failed. In all cases starting olefin was isolated in

almost quantitative amount.

3. Reaction of α -dialzo acetophenone with α -methyl-3,4-dihydronaphthalene.

50 ml benzene solution of 2.5 gm (0.017 mole) of α -dialzo acetophenone was added drop by drop to a 100 ml refluxing benzene solution of 3 gm of α -methyl-3,4-dihydronaphthalene and 0.5 gm active copper powder in presence of nitrogen atmosphere. After refluxing for 3 hrs copper powder was filtered out and benzene was removed completely at reduced pressure. The remaining solid residue was extracted with ether and treated with 5% sodium bicarbonate solution and washed with water till neutral. Ethereal solution was dried over anhydrous sodium sulphate and ether was removed. The liquid residue was fractionally distilled, b.p. $120^{\circ}/7$ mm about 2.5 gms of liquid product distilled over and this was identified as starting olefin by comparison of I.R. and boiling point.

The residue in the flask was dissolved in boiling pet ether and this was concentrated and kept in the cold when yellow coloured crystals separated. This was recrystallised from pet-ether and the yellow crystals thus separated was identified as trans-1,2-dibenzoyl ethylene from its I.R. and melting point comparison with those of an authentic compound.

4. Reaction of diazo methyl cyclohexyl ketone with o-methoxy methyl cinnamate.

50 ml benzene solution of diazo ketone prepared from 5 gm cyclohexyl carboxylic acid chloride was added dropwise to a refluxing benzene solution of 6 gm o-methoxy methyl cinnamate and 0.1 gm active copper powder in the presence of nitrogen atmosphere. After refluxing for 6 hrs the copper powder was removed by filtration and benzene was removed completely and residue was treated with ether which was washed first with sodium bicarbonate solution and then with water till neutral. Ether removed and liquid left behind did not crystallise out from common solvents. So this was distilled b.p. $170^{\circ}/10$ mm G.L.C of the product gives only one peak- Fig. 61.

Its 2:4 dinitro phenyl hydrazone derivative was prepared and crystallised from chloroform/methanol solvent mixture. m.p. of this derivative was found to be 216°C . Elemental analysis of this derivative is in good agreement of the derivative of 1-cyclohexyl carbonyl-2-carbomethoxy-2'-(o-methoxy) phenyl cyclopropane.

Analysis found: N, 11.03%

Calculated for $\text{C}_{25}\text{H}_{28}\text{O}_7\text{N}_4$: N, 11.31%.

5. Reaction of α -diazo acetophenone with methyl crotonate.

50 ml benzene solution of 5 gm of α -diazo acetophenone was added dropwise to 100 ml refluxing benzene solution of

3 gm of methyl crotonate and 1.00 gm active copper powder in presence of nitrogen atmosphere. After refluxing for 6 hrs. Copper powder was filtered out and benzene was removed completely at reduced pressure. The residue was extracted with ether and treated 5% sodium bicarbonate solution and washed with water till neutral. Ethereal solution was dried over anhydrous sodium sulphate and ether was removed. The liquid residue was fractionally distilled, b.p. 135/2.5 mm. This was identified as cyclopropane derivative of methyl crotonate by elemental analysis and I.R. Yield-1 gm.

Analysis found:	C, 71.21%; H, 6.16%
Calculated for $C_{13}H_{14}O_3$:	C, 71.56%, H, 6.42%
I.R. (neat) Fig. P.19	

Residue in distilling flask was crystallised from pet ether and the yellow coloured solid was identified as trans 1,2 dibenzoyl ethylene by mixed m.p. method.