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# Synthesis of 1-diazo-3-methoxy-3-phenyl-2-propanone and reaction with boron trifluoride etherate

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SYNTHESIS OF 1-DIAZO-3-METHOXY-3-PHENYL-2-PROPANONE  
AND REACTION WITH BORON TRIFLUORIDE ETHERATE

by


Harvey Harris Kagan UC 1964

Senior Thesis Submitted  
in Partial Fulfillment  
of the Requirements of Graduation

DEPARTMENT OF CHEMISTRY

UNION COLLEGE

MAY 1964



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This Thesis

Submitted by

Harvey Harris Kagan

to the

Department of Chemistry of Union College

in partial fulfillment of the requirements of the degree of

Bachelor of Science with a Major in Chemistry

is approved by

Howard E. Sheffer

### Acknowledgements

I am truly grateful to Dr. Howard E. Sheffer not only for his constant help and advice, without which this endeavor would not have been as successful. I am also indebted to him for his patience and guidance which have served to place future goals within my sight.

I would also like to extend my thanks to Francesco A. Belli for his help.

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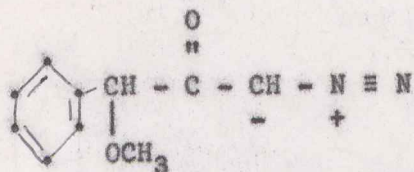
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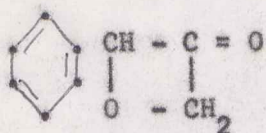
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## Introduction:

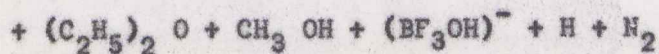
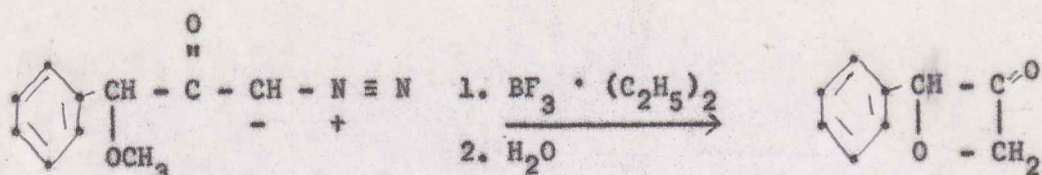
It has been found that the normal reaction of diazoketones with an acid to form substituted methyl ketones is often subverted by cyclization to form closed chain cyclic ketones. Some work has been done with aromatic diazoketones but very little has been done with the aliphatic diazoketones. The object of this research was to bring about ring closure of a four membered ring from an aliphatic diazoketone. It was decided to put a phenyl group on the aliphatic chain in order to obtain crystalline derivatives. Specifically, the object of this work was to bring about the cyclization of 1-diazo-3-methoxy-3-phenyl-2-propanone:



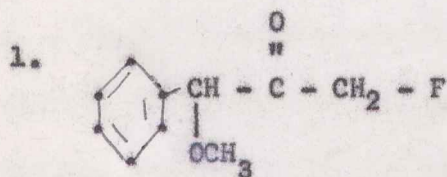
with the Lewis acid, boron trifluoride ( $\text{BF}_3$ ) to form 2-phenyl oxetanone-3:



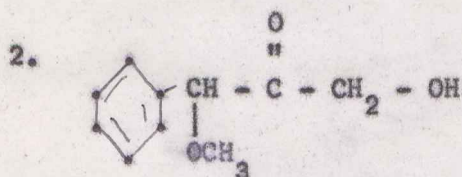
by the following reaction:



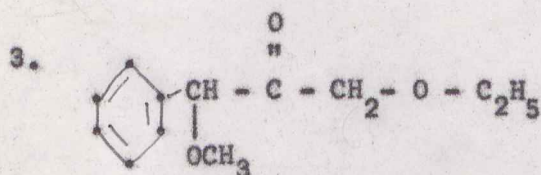
Because of the presence of more than one nucleophile in solution, more than one product is expected. Four other major products are anticipated. They are the fluoro<sup>1</sup>, hydroxy<sup>2</sup>, and ethoxy<sup>3</sup> substituted methyl ketones and 1-methoxy indanone-2<sup>4</sup>. The amount of each product obtained is a measure of the relative strengths of the competing nucleophiles.



1-fluoro-3-methoxy-3-phenyl-2-propanone

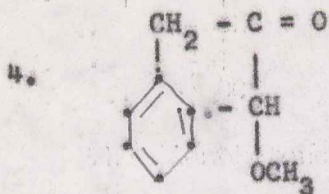


1-hydroxy-3-methoxy-3-phenyl-2-propanone

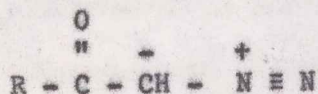


1-ethoxy-3-methoxy-3-phenyl-2-propanone

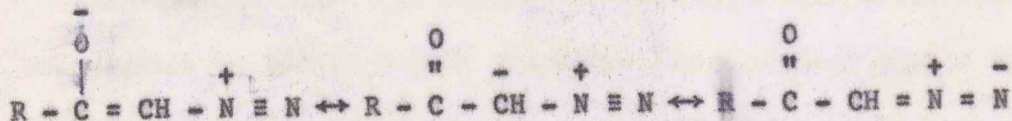




The diazoketones which appear in this paper shall be written as:



Actually the true structure is a resonance hybrid of the three forms:

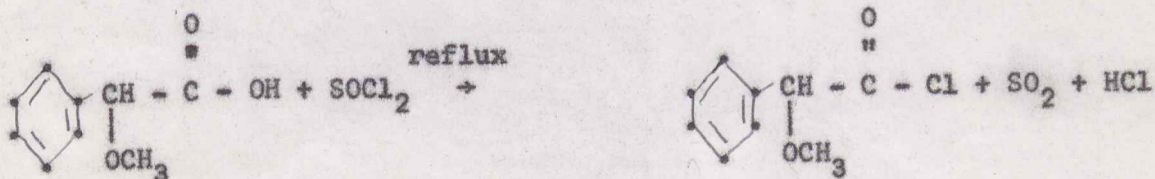


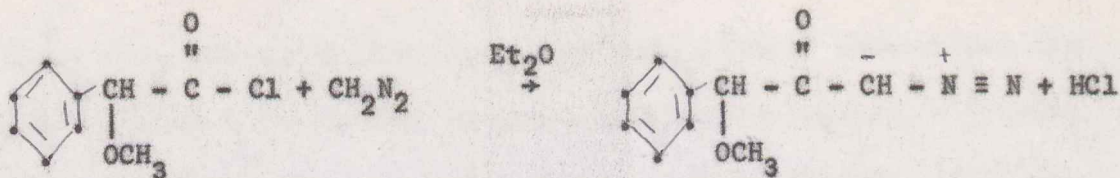
The diazoketone must be synthesized from the respective acid, D, L - phenyl-2-methoxy-acetic acid, by a series of steps which involve: (1) the conversion of the acid to the acid chloride upon treatment with thionyl chloride, (2) the conversion of the acid chloride to the diazoketone upon treatment with diazo methane.

Diazomethane will be written:  $\text{CH}_2\text{N}_2$ . It is actually a resonance hybrid of the two forms:



The proposed synthesis is as follows:



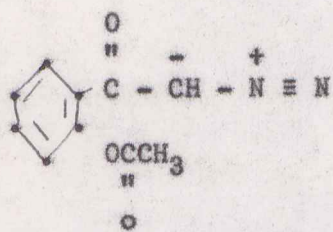


### Historical:

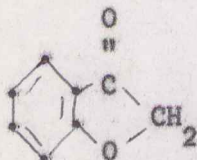
The first recorded mention of diazoketones was made at the beginning of the 20th century by the German Chemist L. Wolff.<sup>13</sup> He formulated what is now known as the Wolff rearrangement. In this process diazoketones are converted to their corresponding acids or esters in the presence of silver ions.

Soon after, Arndt and Eistert<sup>14</sup> discovered that diazoketones may be prepared by treating acid chlorides (or bromides) with a cold ethereal solution of diazomethane. It is this procedure that I shall use in the preparation of 1-diazo-3-methoxy-3-phenyl-2-propanone.

Elderfield, Kuch, and Marshall were successful in reacting  $\alpha$ -diazo-*o*-acetoxyacetophenone:



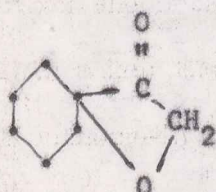
with glacial acetic acid to form the cyclic compound coumaranone:



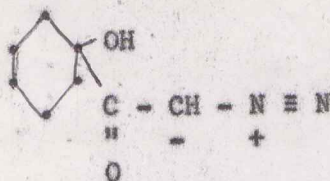
They found that the reaction of the meta compound with glacial acetic acid yielded the open chain substituted methyl ketone; *o*-acetoxy-*m*-acetoxyacetophenone.

Ten years later, in 1952, A.K. Bose and P. Yates<sup>3</sup> generalized that the cyclic product coumaranone could be obtained by treating  $\alpha$ -diazo-O-methoxyacetophenone with catalytic amounts of hydrogen ions. Only catalytic amounts of acid were required since the proton was recovered when methanol is split off by solvolysis of the oxonium intermediate.

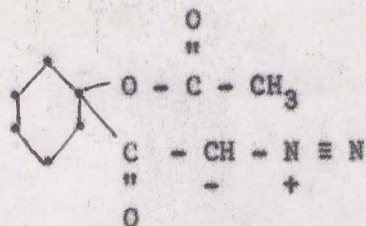
Marshall and Walker<sup>8</sup> were able to obtain a four membered heterocyclic ketone (1-oxaspiro (3,5) nonan-3-one):



from both 1, hydroxy - 1 -  $\omega$  - diazoaceto cyclohexane:



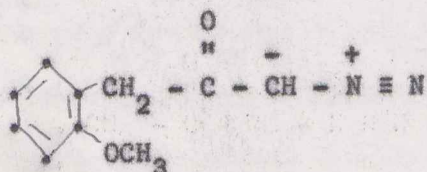
and 1, acetoxy - 1 -  $\omega$  - diazoaceto cyclohexane:



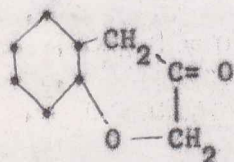
An attempt to prepare oxetanone-3 was made by Kennar and Richards<sup>6</sup>. Different acids were used as catalysts, however, the amounts of cyclic

compounds reported is so small as to be classified insignificant.

In 1951 Pfeiffer and Endres<sup>9</sup> expanded the work by experimenting with various solvents and acids. They attempted the ring closure of 1-diazo-3-(*o*-anisyl)-2-propanone:



to 3-chromanone:



with hydrochloric and obtained only the open chain products; 1-chloro-3-(*o*-anisyl)-2-propanone. In 1962 Sheffer and Moore<sup>11</sup> found that ethereal acetic acid gave only the open chain acetoxy product. An ethereal solution of conc. sulphuric acid gave the open chain dialkyl sulfate and a small amount of the cyclic. A solution of catalytic amount of sulfuric acid in aqueous dioxane produced the open chain hydroxy compound plus the desired cyclic compound. The results of the work of Sheffer and Moore may be summarized in the following table.

Acid	Equiv. Ratio Acid/Diazoketone	Solvent	Yield %	
			Chromanone	Open Chain Prod.
Acetic	3.4	Ether	-	42
Sulfuric	1.0	Ether	4	19
Sulfuric	0.04	Aqueous Dioxane	15	45
H <sub>2</sub> O	1.5	Ether	35	-

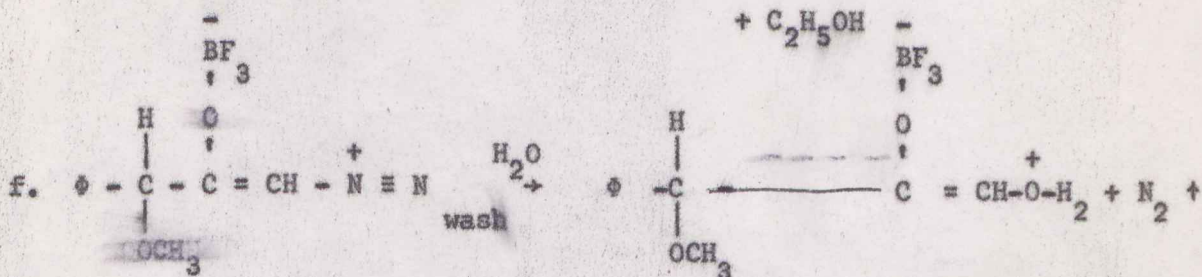
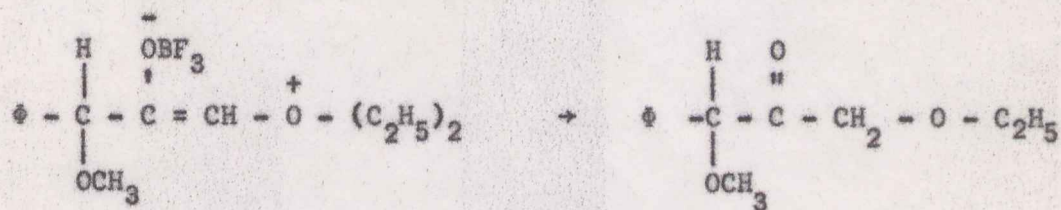
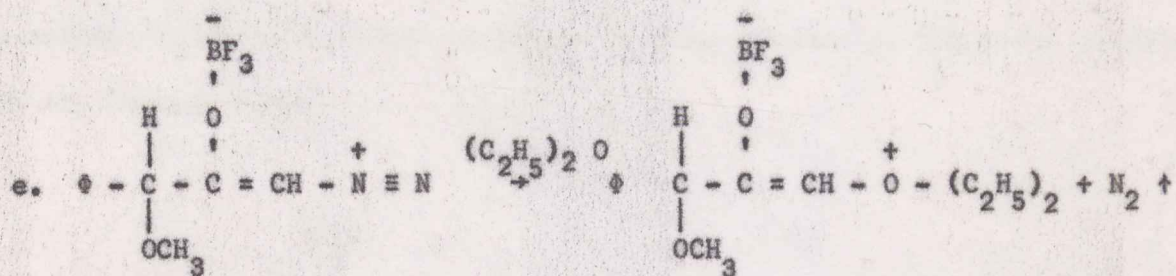
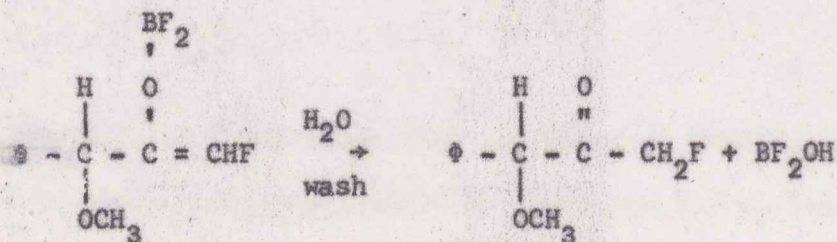
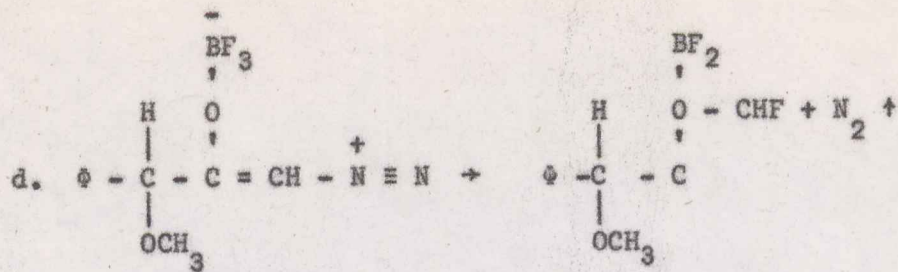
They suggested that the use of boron trifluoride etherate increased the nucleophilicity of the methoxy-oxygen atom, relative nucleophilicity being a controlling factor in bringing about ring closure. Cyclization is most favored when boron trifluoride etherate is used because this represents essentially a case in which competition from the anions of the mineral acid is eliminated and no effective nucleophile is present.

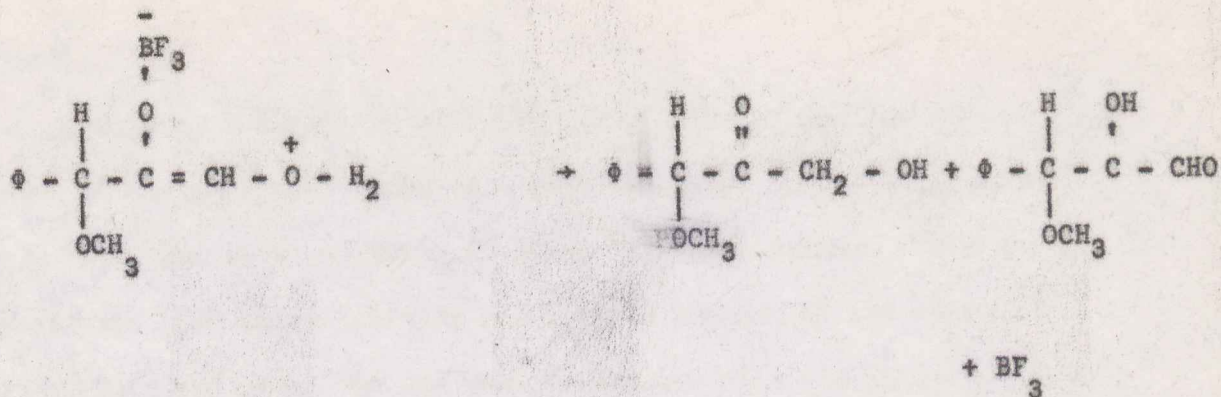
It is interesting to note that Sheffer and Moore were able to isolate (1) a fluoro compound and an (2) ethoxy and (3) hydroxy compound. It is believed that the nucleophiles involved here were supplied by (1) the boron trifluoride itself and, (2) the ethyl ether solvent.

They proposed that the formation of the cyclic product involves the formation of an oxonium ion when sulfuric acid is used and an oxonium ion fluoroborate ion when boron trifluoride is used. This is followed by a nucleophilic attack at the methyl group. Their proposed mechanism essentially consists of: (1) formation of an oxonium fluoroborate ion, (2) loss of nitrogen, (3) nucleophilic attack of a neighboring group, or in the formation of an open chain compound, by another nucleophile, and (4) hydrolysis of the resulting oxonium fluoroborate ion. This hydrolysis is affected by washing the reactants with water which leads either to the formation of an ethyl ether or the formation of some open chain hydroxy product depending on which way the oxonium ion is cleaved.

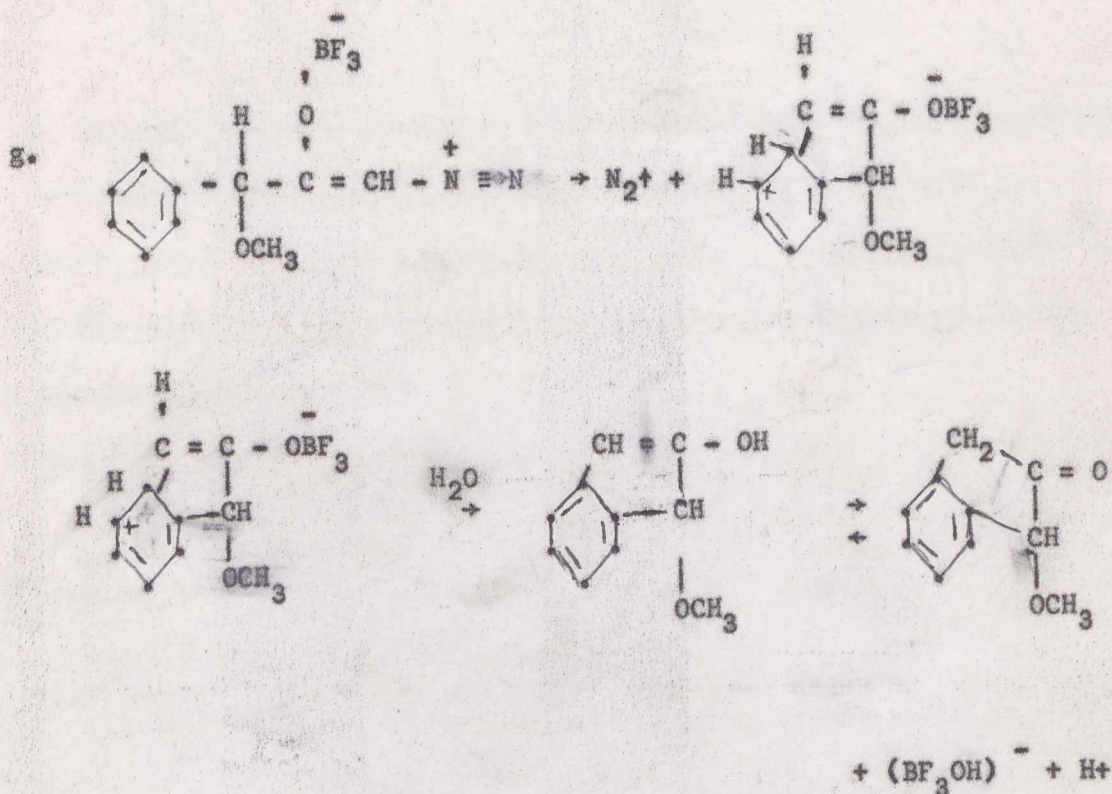
Based on the conclusions drawn by Sheffer and Moore, a mechanism is proposed for the reaction of 1-diazo-3-methoxy-3-phenyl-2-propanone with boron trifluoride etherate:







Previous work has shown that the electron density in the benzene ring makes the ortho position especially favorable for nucleophilic attack.<sup>11</sup> This makes the formation of a 5 membered ring feasible. This compound, 1-methoxy-indanone-2, would be formed by ring closure at the ortho position in the benzene ring.



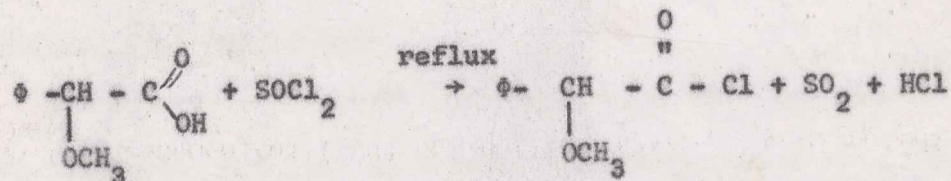


## Experimental:

In reading the experimental portion of this paper, one should be aware of the fact that phenyl - $\alpha$ - methoxy acetyl chloride decomposed when distilled at atmospheric pressure to benzaldehyde. This was discovered late in the project and a large portion of the research was carried out under the mistaken impression that the phenyl- $\alpha$ - methoxy acetyl chloride had remained intact.

### Preparation of phenyl - $\alpha$ - methoxy acetyl chloride

Phenyl - - methoxy acetyl chloride was prepared by the method of Gilman and Blatt<sup>4</sup>.



D, L-phenyl - $\alpha$ - methoxy acetic acid (Kodak), 24.9g (0.15 moles), was refluxed for 45 min. in a one liter three-necked flask with 13.6 (0.17 moles) of thionyl chloride, b.p. 77°. Fractional distillation of the resulting amber coloured liquid yielded three fractions and polymeric residue.

<u>Fraction</u>	<u>Boiling point</u>	<u>Pressure</u>	<u>Weight</u>	
1-1	90°-100°	63m.m.	1.8960	g
1-2	100°-110°	42m.m.	10.5480	
1-3	150°-160°	32mm.	1.5223	
residue	----	----	1.0725	

Literature value; b.p. 119-121° /26m.m.

Fraction 1-2 was calculated to be a 50% yield, assuming that it was the acid chloride, which later proved to be an incorrect assumption.

A second batch was prepared using 49.8 g (0.30 moles) D, L-phenyl-  
l-methoxy acetic acid and 27.2 ml (0.34 moles) thionyl chloride. Fractional distillation again resulted in three fractions and polymeric residue.

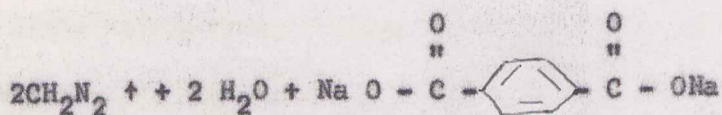
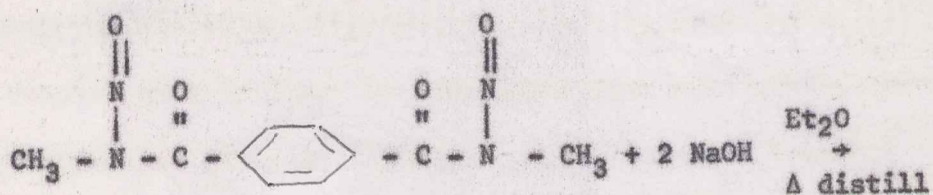
<u>Fraction</u>	<u>Boiling point</u>	<u>Pressure</u>	<u>Weight</u>
2-1	178-182°	1 atm.	24.4244 g
2-2	184-190°	1 atm.	2.1280
2-3	220-250°	1 atm.	3.7491
residue	----	----	0.7239

2-1 and 2-2 were combined to form 3-1 (48% yield, again assuming the product to be acid chloride.)

Fractions 1-2 and 3-1 were combined to form 4-1 which was 0.20 moles of the acid chloride

#### Preparation of Diazomethane:

Diazomethane is prepared by the method of Reed and Moore<sup>10</sup> by the action of alkali on either an N-methyl-N-nitroso amide or urea.



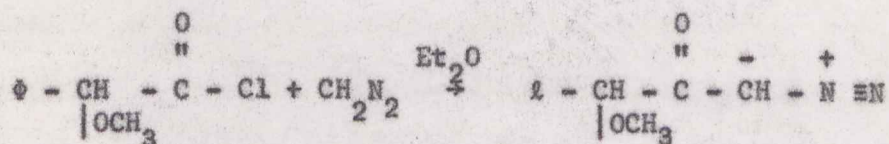
Two five liter, three-necked flasks are joined by a 60 cm water condenser and adapters. The generator flask is equipped with a heating mantle and a goose neck. There is a stopcock at the mouth of the receiving flask. The receiving flask is surrounded by an ice-salt bath in order to reduce the danger of explosion. It is then filled with enough

anhydrous ether to cover the bottom of the adapter in order to reduce the loss of diazomethane. Approximately 300 ml. is used. The generator flask is filled with 3 liters of ether, 450 ml. of diethylene glycol monoethyl ether (Matheson, Coleman, and Bell) and 600 ml. of 30% NaOH. It is thoroughly mixed and brought to a temperature of 5°C. Then 180 g (0.5 moles) of diazomethane precursor N, N'-dinitroso - N, N' dimethyl terephthalamide, (Dupont) is introduced into the flask and the mixture is heated moderately until the diazomethane in ether begins to distill. Originally the reactants are a yellow color after approximately two or three hours the yellow color disappears and the reaction is complete. At this point the heat is removed. After standing for two hours the receiving flask is disengaged.

The anticipated yield of diazomethane from one half a mole of the precursor is one mole. However, some loss is anticipated and reaction with benzoic acid followed by back titrations with sodium hydroxide have shown the actual yield to amount to approximately 0.8 mole.<sup>5</sup>

Preparation of 1-diazo-3-methoxy-3-phenyl-2-propanone

1-diazo-3-methoxy-3-phenyl-2-propanone is prepared by the method of Arndt and Eistert<sup>14</sup>.



The acid chloride (0.20 moles) was diluted with an equal volume of absolute ether and was added to the diazomethane etherate (~0.80 moles). In this reaction at least a 2:1 excess of diazomethane is

desired. The evolution of nitrogen was observed.

#### Reaction with Boron Trifluoride Etherate

Freshly distilled boron trifluoride etherate, 28.4g (0.20 moles) was dissolved in 450 ml. of anhydrous ether. This solution was then added from a graduated separatory funnel, in increments of 25 ml., to the diazoketone. The amount of liberated nitrogen was collected in the inverted one liter graduate cylinder. Nitrogen was liberated spontaneously as the boron trifluoride solution was added to the diazoketone. However, the nitrogen was liberated only as long as the boron trifluoride solution was added. When the first addition (25 ml.) of the boron trifluoride was discontinued the nitrogen ceased to be given off. This phenomenon was observed until 100 ml. of the boron trifluoride solution had been added. At this point 2.0l of nitrogen had been collected. The addition of an excess of 50 ml. of the boron trifluoride solution, after a wait of one hour, failed to liberate any more nitrogen. At this point the addition of boron trifluoride solution was discontinued.

Expected liberated nitrogen = 0.2 moles = 4.51l

Actual liberated nitrogen = 0.09 moles = 2.01l

The material, which had an orange color, was transferred into a one liter separatory funnel and washed four times with 50 ml. portions of distilled water. After the washings the material had a yellow color. It was then washed four times with 50 ml. portions of 10%  $\text{NaHCO}_3$ , in order to remove any excess boron trifluoride. The  $\text{H}_2\text{O}$  washings serve to effect hydrolysis.

The yellow ether solution of the reaction products was left in the reaction flask and most of the ether was removed by evaporation under vacuum. The remaining ether was removed by fractional distillation since its boiling point was far below the boiling points of the reaction products. The material was next dried through anhydrous sodium sulphate after which it was transferred into a small distillation flask to be fractionally distilled. The results of that distillation are as follows:

<u>Fraction</u>	<u>Boiling Point</u>	<u>Pressure</u>	<u>Approx. Vol.</u>	<u>Weight</u>
21-1	65°-80°	28 m.m.	9.5 c.c.	10.6632 g
21-2	55°-65°	6 m.m.	3.0 c.c.	13.0287
21-3	80°-100°	6 m.m.	1.5 c.c.	0.9240
21-4	140°-150°	6 m.m.	0.5 c.c.	0.9852
21-5	175°-185°	6 m.m.	4.0 c.c.	5.6366
21-6	220°-225°	6 m.m.	1.5 c.c.	1.7561

The distillation was carried out in a Cottonseed oil bath.

#### Vapor Phase Chromatography

The first five fractions were run on an F and M 720-dual column - programmed temperature - gas chromatograph, to determine their purity. Five  $\mu$ liter samples were run at a temperature which was programmed to rise from 100° to 250° C at a rate of 5°/min. A copper column packed with silica grease was used and the helium flow rate was 60 c.c./min. Fraction 21-6 was not run due to its extremely high viscosity. The results of the five runs are as follows:

<u>Fraction</u>	<u>Number of Major Peaks</u>	<u>Number of Minor Peaks</u>
21-1	2 (A,B)*	0
21-2	2 (B,C)	1 (A)
21-3	3 (B,C,E)	1 (D)
21-4	3 (W,X,Y)	1 (Z)
21-5	4 (W,X,Y,Z)	0

\*peaks are arbitrarily labeled with letters A,B, etc. in order that they may be identified in order of increasing retention times.

On the basis of previously recorded literature values for boiling points<sup>11</sup>, it was decided that the cyclic compound, if it was present, would be in the low boiling fraction (21-1).

Preparation of D.N.P. derivatives

Without further separation it was decided to prepare 2,4-dinitro-phenylhydrazone derivatives of fractions 21-1 - 21-5. One millimole (0.198 g) of 2,4 dinitrophenylhydrazine was dissolved in 10 ml. of Ethanol. Four drops of concentrated HCl were added to the hot solution. One millimole \* of the fraction to be tested was then added and the solution was set to crystalize in the refrigerator.

<u>Fraction</u>	<u>Number of Derivatives Seen</u>	<u>Melting points (crude)</u>
21-1	(1) Light orange needles	225°-230° (0.312g)
21-2	(2) Light orange needles Light yellow needles	225°-230° 135°-140°
21-3	(4) Light orange needles Orange needles Orange needles Dark red needles	225°-230° 205°-210° 175°-180° 190°-195° +
21-4	(3) Orange needles Orange needles Dark red needles	205°-210° 175°-180° 190°-195°+
21-5	(2) Orange needles Dark red needles	175°-180° 190°-195°+

The yield of 21-1 was 95%, assuming it to be 2-phenyl oxetanone-3.

+ thought to be DNP itself, by mixed melting points

\* One millimole was approximated assuming that the identities of the fractions were as follows:

21-1: cyclic, 21-2: cyclic, 21-3: fluoro, 21-4: hydroxy, 21-5: hydroxy

These assumptions were made based on their relative boiling points.

Since only one derivative was formed from fraction 21-1 it was suspected that perhaps the two fractions showing up on the V.P.C. were the enol and keto form of the same compound. This hypothesis was tested by running a sample of 21-1 through the V.P.C. again. This time the first fraction was collected from the exit tube and rerun. Since the keto-enol equilibrium is established almost instantaneously two peaks would again result on the graph if the two fractions were truly the keto and enol forms of the same compound. This hypothesis proved to be incorrect since only one peak showed up on the rerun of the collected sample.

One millimole of D.N.P. reacted with 0.183 g (1.52 millimoles) of 21-1 to give 0.217 g (78% yield based on the later realization that 37-2 was acetophenone) of D.N.P. derivative, m.p. 227-232°

calculated for D.N.P. of 2-phenyl oxetanone - 3'C, 55.00;  
H, 3.66; N, 17.06

calculated for D.N.P. of 1-methoxy indanone-2'C, 56.14;  
H, 4.12; N, 16.37

observed analysis for D.N.P. of 21-1'C, 55.68; H, 3.76;  
N, 18.55

21-1 was recrystallized from ethanol.

observed: N, 18.66

#### Separation of 21-1 into two components by vapor phase chromatography

It was decided that since the boiling points of the two components of 21-1 were extremely close together, another fractional distillation would be pointless. Vapor phase chromatography seemed to be the only available method of separation. The F and M 720 dual column chromatograph was again equipped with a copper column packed with firebrick

coated with silica grease. Twenty  $\mu$  l samples were used and the instrument was run isothermally at 100°, helium flow rate of 60 c.c./min. and an attenuation of 8.

Twenty five runs were made. Each of the two fractions was collected from the exit tube as it separated from the mixture. The samples 37-1 and 37-2) were saved for Infrared Spectroscopy and Nuclear Magnetic Resonance (N.M.R.) Spectroscopy.

<u>Fraction</u>	<u>Retention Time</u>	<u>Peak Height</u>	<u>Area Under Curve</u>
37-1	3.4 min.	14.0	29.5%
37-2	12.0 min.	11.8	70.5%

#### Crystallization of 37-1 from 37-2

During V.P.C. work, it was noticed that 37-1 was a solid and 37-2 a liquid at room temperature. It was decided to attempt crystallization of 37-1 from 37-2. The solution was placed in the refrigerator for 24 hours and the solid did crystallize out of solution. It was filtered on a Hirsch Funnel and the mother liquor was replaced in the refrigerator so that more solid could crystallize out. The process was repeated six times until no more solid came out of solution. The solid was re-crystallized from hot ligroin (B.R. 30°-60°) five times, m.p. 110°-115°.

Calculated for Benzoic Acid: C, 68.91; H, 4.90

Observed analysis for 37-1: C, 68.73; H, 4.91

Infrared spectra and mixed melting points confirmed that 37-1 was benzoic acid.

A D.N.P. derivative was prepared from 37-2, m.p. 236°-239°.

Calculated for D.N.P. of acetophenone: C, 56.05; H, 4.03; N, 18.67

Observed analysis of D.N.P. of 37-2: C, 55.49; H, 4.06; N, 18.02.



Infrared spectra and mixed melting points confirmed that 37-2 was acetophenone.

Infrared spectra were obtained on a Perkin-Elmer 137 Infracord recording infrared absorption spectrometer, with Sodium Chloride optics. 37-2 was run neat. 37-1 was run in chloroform solution.

The melting point of the DNP derivative of 37-2 (236°-239°) matches the melting point of the DNP of acetophenone (238°-240°) very well. The melting point of 37-1 (110°-115°) matches that of benzoic acid (122°). Additional evidence for 37-2 is supplied by its refractive index  $n_D^{20} = 1.5373$ . The refractive index of acetophenone is  $n_D^{20} = 1.5342$ .

Nuclear Magnetic Resonance Spectroscopy

The proton spectra of both 37-1 and 37-2 were obtained using the Varian A-11 Nuclear Magnetic Resonance Spectrometer. Tetramethyl silane was used as a standard frequency response. 37-1 was dissolved in deuteriochloroform. 37-2 was run neat.

Fraction 37-2 (neat)	500 CPS	(Acetophenone) <sup>2</sup>
<u>Frequency</u>	<u>Area Under Curve</u>	<u>Tentative Identification</u>
1.75 $\tau$	5	{ (b) 2 meta (c) 1 para Benzene hydrogens
2.23 $\tau$		
7.17 $\tau$	3	(d) 2 ortho Benzene hydrogens (e) 3 methyl hydrogens
Fraction 37-2 (neat)	1000 CPS	(Acetophenone) <sup>2</sup>
<u>Frequency</u>	<u>Area Under Curve</u>	<u>Tentative Identification</u>
1.75 $\tau$	5	{ (b) 2 meta (c) 1 para Benzene hydrogens
2.29 $\tau$		
7.20 $\tau$	3	(d) 2 ortho Benzene hydrogens (e) 3 methyl hydrogens

Fraction 37-1  
(in deuteriochloroform)

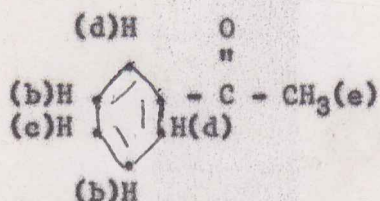
1000 CPS

(Benzoic Acid)<sup>2</sup>

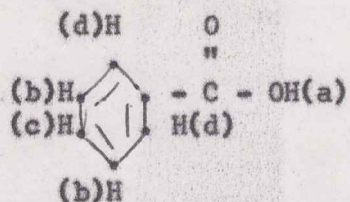
<u>Frequency</u>	<u>Area Under Curve</u>	<u>Tentative Identification</u>
-2.50 $\tau$	1	(a) 1 Carboxyl Hydrogen
1.30 $\tau$	5	{ (b) 2 meta (c) 1 para Benzene Hydrogen
1.80 $\tau$		
7.20 $\tau$	-	impurity from 37-2 (methyl hydrogens)

The structure may be represented as follows:

Acetophenone:



Benzoic Acid

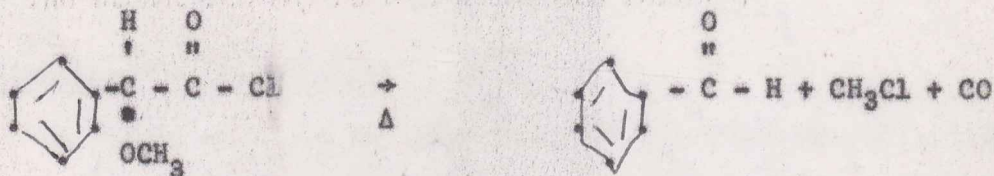


It has been shown that there is variable shielding of ortho, para and meta hydrogens in the benzene ring.<sup>6</sup> This may be applied to both acetophenone and benzoic acid. No spin splitting occurs in the three

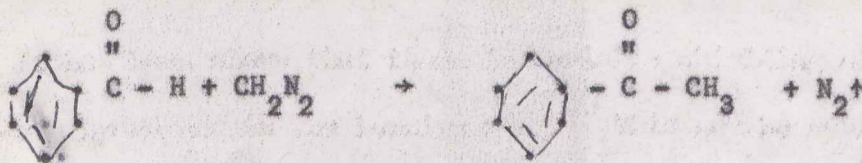
methyl hydrogens of acetophenone. Some impurity from 37-2 showed up in the spectrum of 37-1 in the form of a small peak at 7.20  $\tau$  from the methyl hydrogens of acetophenone.

### Discussions and Conclusions

It is thought that some of the *o*-methoxy-phenyl acetyl chloride originally formed by the action of thionyl chloride on D, L-*o*-methoxy phenyl acetic acid decomposed to form benzaldehyde<sup>1</sup> by the following reaction before or during distillation:



The 45% recovery of nitrogen during the boron trifluoride reaction points to the existence of a subverting reaction which would lower yields of diazoketone. The boiling point of the product obtained after distillation of the acid chloride was 178°-182°C at 1 atm. This is much lower than the expected boiling point of the acid chloride (119°-121°/26mm.)<sup>1</sup> It matches the boiling point of benzaldehyde (b.p. 179°C.) very well. Probably some of this benzaldehyde was oxidized on standing to form benzoic acid which was isolated later. (37-1). Apparently the remaining benzaldehyde reacted with diazomethane to form acetophenone.<sup>14</sup> (37-2).



It is thought that since some Nitrogen (2.0 l) was collected during the  $\text{BF}_3$  reaction, it is highly probable that some acid chloride managed to get through without decomposing. This "true" acid chloride probably reacted with the  $\text{BF}_3$  etherate and formed a portion of the higher boiling fractions. (21-1 - 21-6, especially 21-5). Perhaps, in these fractions may be found 2-phenyl-oxetanone-3, 1-methoxy-indanone-2, and/or any number of the open chain compounds (e.g. fluoro, ethoxy, hydroxy). Unfortunately, lack of time forced us to concentrate on analysis of fraction 21-1 and no analysis was attempted on fractions 21-2 - 21-6.

#### Suggestions for Future Work

For future work, it is suggested that the final distillation be carried out using a more efficient fractionating column such as a spinning band type. This would give a higher degree of purity and eliminate some of the difficulty of separation.

It is also suggested that the vapor phase chromatograph be employed all along the route of the synthesis in order to check the purity of the products.

The analysis of the higher boiling fractions in this synthesis would probably prove most profitable. The greater utilization of "wet" chemical techniques is recommended.

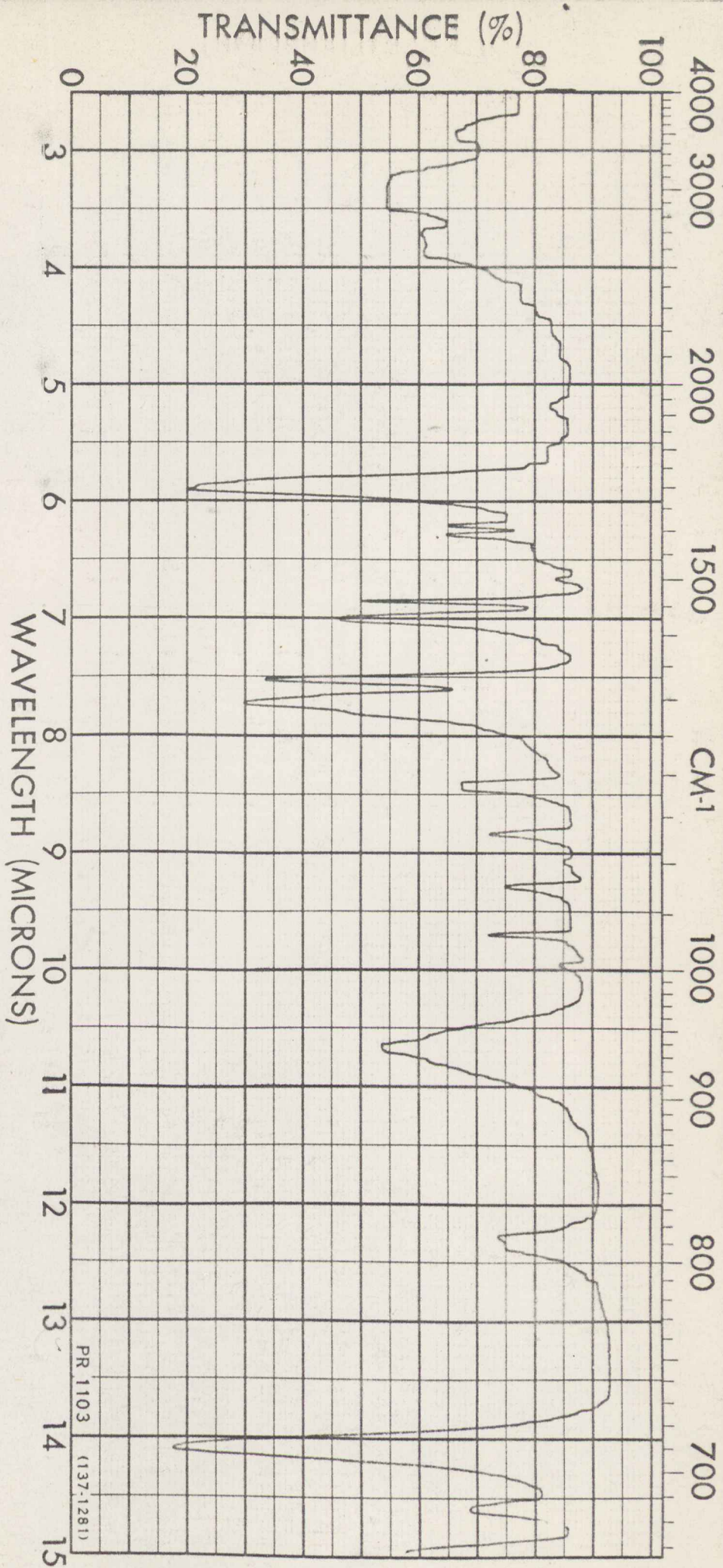
It is also recommended that much attention be given to the boiling points of various intermediate in the synthesis as compared to literature values of similar products.

Finally, it is emphatically recommended that the fractional distillation of the acid chloride be carried out at very low pressures and tempera-

tures in order to prevent their decomposition to benzaldehyde. Phenyl-  
 $\alpha$ -methoxy acetyl chloride decomposes at 15 m.m. upon distillation.<sup>1</sup>  
The distillation should therefore be carried out at low pressures near  
1 m.m. of Hg.

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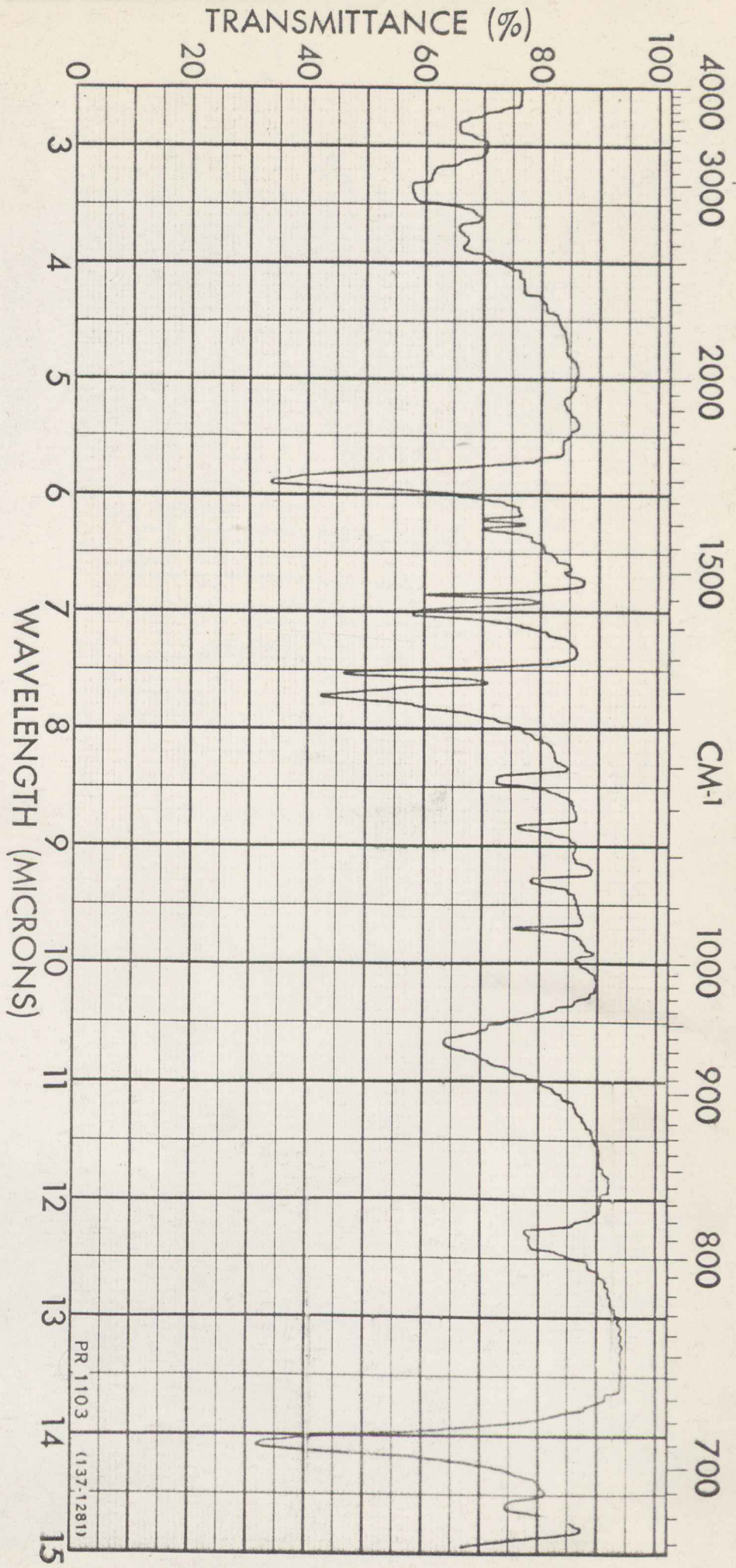
PR 1103 (137-1281)

-24-A-

SPECTRUM NO. _____		ORIGIN _____		LEGEND _____		REMARKS _____	
SAMPLE <u>37-1</u>		PURITY _____		1. _____			
<u>M. to solid</u>		PHASE _____		2. _____			
_____		THICKNESS _____		DATE _____			
_____				OPERATOR _____			

SAMPLE SPECTRUM NO. \_\_\_\_\_

RECORDED ON QUARTZ

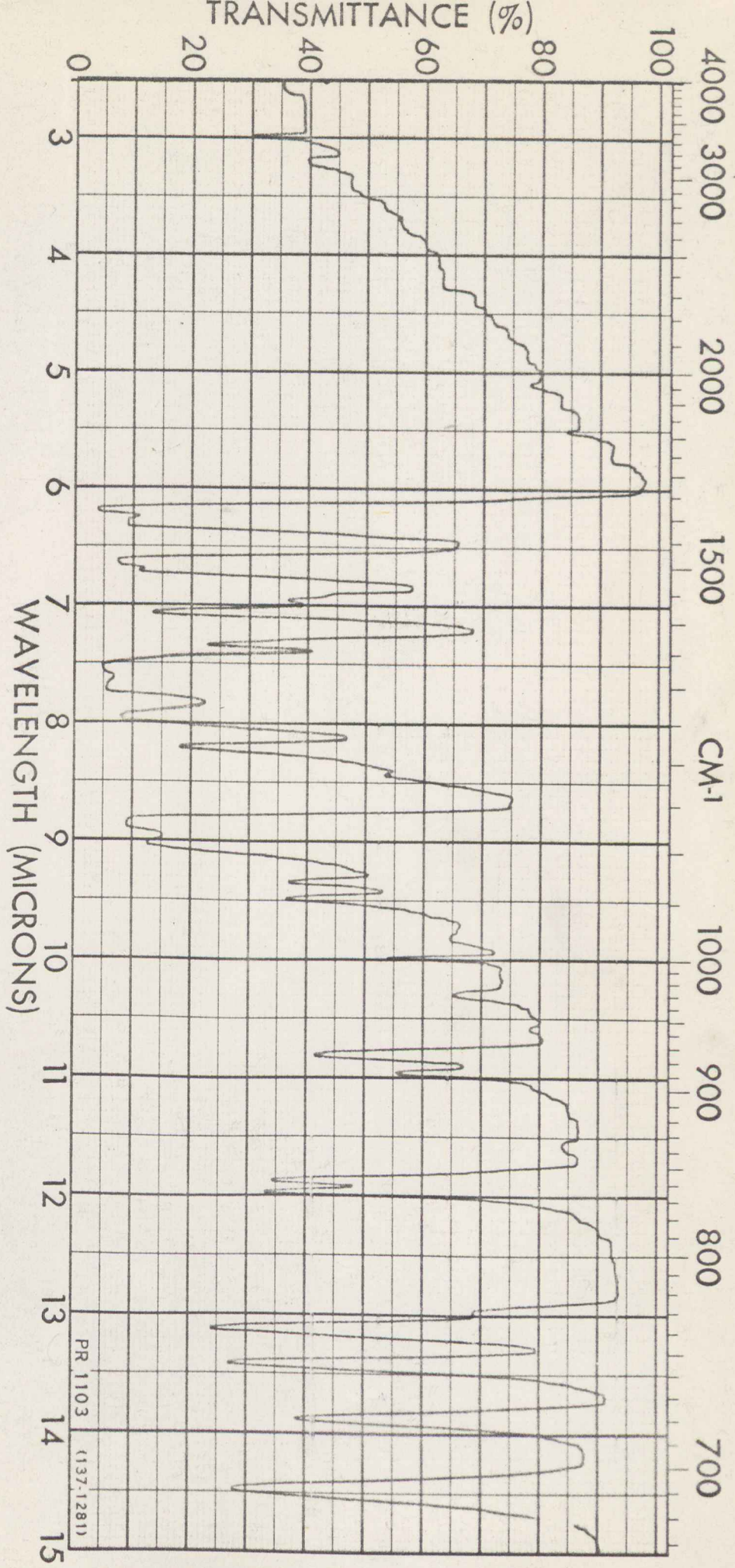


SPECTRUM NO. _____ SAMPLE <u>Benzoic Acid</u>	ORIGIN _____ PURITY _____ PHASE _____ THICKNESS _____	LEGEND _____ 1. _____ 2. _____ DATE _____ OPERATOR _____
REMARKS _____ _____ _____		

SPECTRUM NO. \_\_\_\_\_

RECORDING CHART

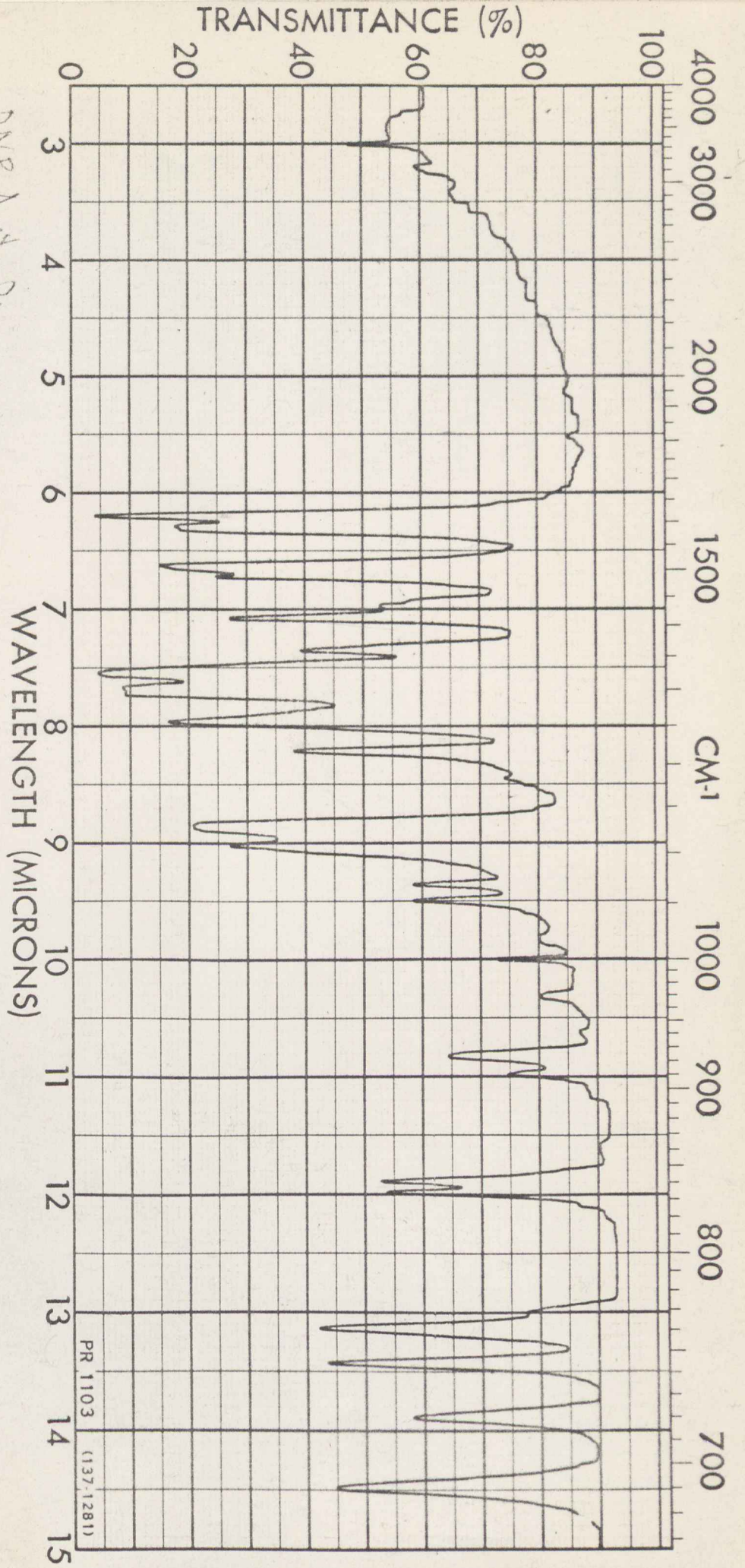




SPECTRUM NO. _____		ORIGIN _____		LEGEND _____		REMARKS _____	
SAMPLE <u>39-2</u>		PURITY _____		1. _____		SAMPLE	
<u>DNP</u>		PHASE _____		2. _____			
		THICKNESS _____		DATE _____			
				OPERATOR _____			

PR 1103  
(137-1281)

SPECTRUM NO. \_\_\_\_\_



*D.N.P. A. J. H. Jones*

SPECTRUM NO. _____ SAMPLE <i>D.N.P.</i> of <i>Acetophenone</i>	ORIGIN _____ PURITY _____ PHASE _____ THICKNESS _____
LEGEND 1. _____ 2. _____	REMARKS _____ _____ _____
DATE _____ OPERATOR _____	_____ _____ _____

PR 1103 (137,12811)

SPECTRUM NO. \_\_\_\_\_  
 SAMPLE \_\_\_\_\_