

## **Copyright Warning & Restrictions**

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be “used for any purpose other than private study, scholarship, or research.” If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of “fair use” that user may be liable for copyright infringement,

This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.

**Please Note: The author retains the copyright while the New Jersey Institute of Technology reserves the right to distribute this thesis or dissertation**

Printing note: If you do not wish to print this page, then select “Pages from: first page # to: last page #” on the print dialog screen

The Van Houten library has removed some of the personal information and all signatures from the approval page and biographical sketches of theses and dissertations in order to protect the identity of NJIT graduates and faculty.

INVESTIGATION OF THE ACID DEGRADATION  
OF  
2-(4-METHOXYBENZYLAMINO)-PYRIDINE

BY

ANTHONY T. OROPOLLO

A THESIS  
SUBMITTED TO THE FACULTY OF  
THE DEPARTMENT OF CHEMICAL ENGINEERING  
OF  
NEWARK COLLEGE OF ENGINEERING

IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE

OF

MASTER OF SCIENCE  
WITH A MAJOR IN CHEMICAL ENGINEERING

NEWARK, NEW JERSEY

1954

195-01-116

APPROVAL OF THESIS

FOR

DEPARTMENT OF CHEMICAL ENGINEERING  
NEWARK COLLEGE OF ENGINEERING

BY

FACULTY COMMITTEE

APPROVED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NEWARK, NEW JERSEY

MAY, 1954

### ACKNOWLEDGEMENT

The author wishes to express his gratitude to Professor James A. Bradley, of the Newark College of Engineering, and to Dr. Peter I. Pollak, of Kerek & Co., Inc., for their advice and assistance throughout the investigation.

TABLE OF CONTENTS

INTRODUCTION. . . . .	.1
DISCUSSION . . . . .	.2
SUMMARY OF REACTIONS . . . . .	12
EXPERIMENTAL PROCEDURES . . . . .	14
CONCLUSION . . . . .	27
REFERENCES . . . . .	28

### INTRODUCTION

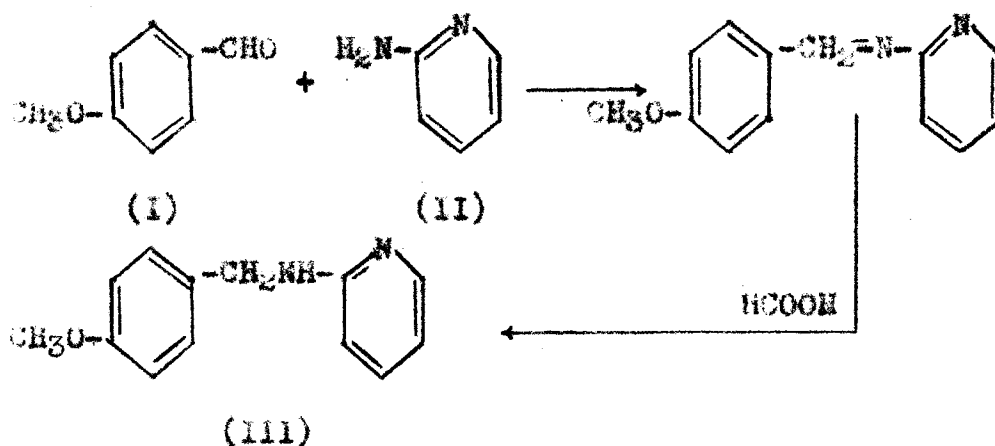
This paper represents work done in connection with an investigation of the products resulting from the reaction of dilute sulfuric acid and 2-(4-methoxybenzyl-amino)-pyridine. Brief contact between these reactants at temperatures below 80°C give rise to a water soluble salt of the amine. The amine may be precipitated from the solution by the addition of sufficient alkali.

Under the conditions considered in this paper, prolonged contact of reactants at temperatures above 80°C, a non-crystalline condensation product is obtained in addition to the amine salt.

Attempts to identify this product were unsuccessful. However, in connection with the characterization work, two relatively little known compounds were produced and identified, 4,4'-dimethoxybenzophenone and 4,4'-dimethoxy-diphenylmethane.

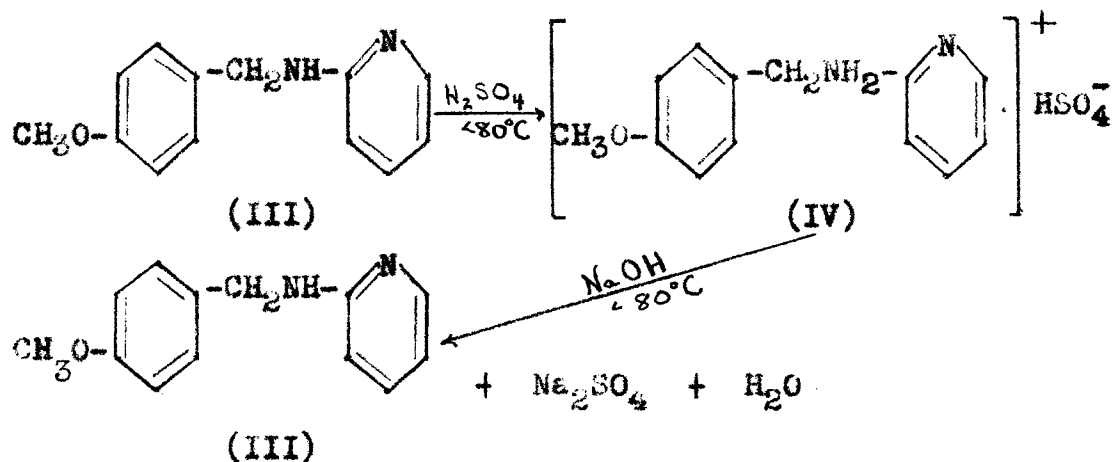
### DISCUSSION

In the course of preparing 2-(4-methoxybenzylamino)-<sup>1,2</sup>pyridine(III) from p-methoxybenzaldehyde(I) and 2-amino-<sup>3,4</sup>pyridine(II) by a variation of the Leuckart process, the formation of an amorphous material was noted which materially affected the yield of the reduced aldehyde-amine adduct.

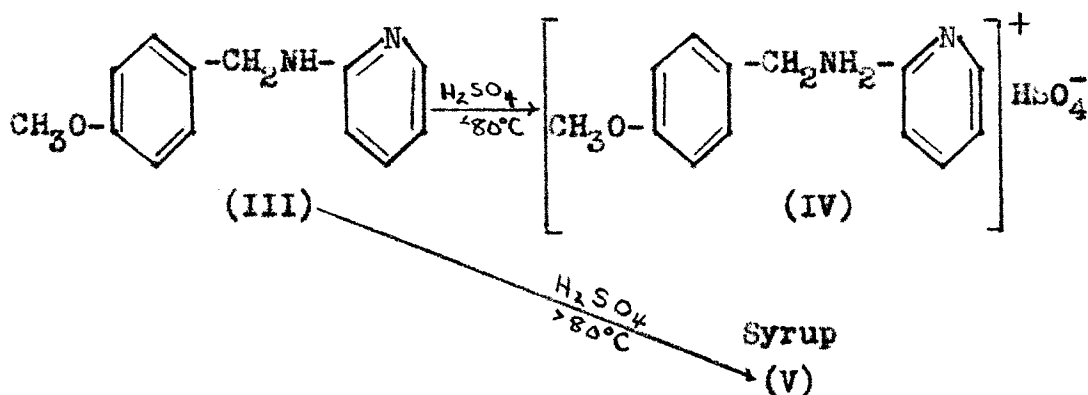


The presence of this substance became apparent during the purification of the 2-(4-methoxybenzylamino)-pyridine, a step in which the newly formed base is brought in contact with dilute sulfuric acid at temperatures below 80°C to form the acid salt(IV), washed with toluene, neutralized with alkali and extracted with toluene while hot. The solution is cooled, and the crystallized 2-(4-methoxybenzylamino)-pyridine is filtered and dried. The yield is approximately 80%.



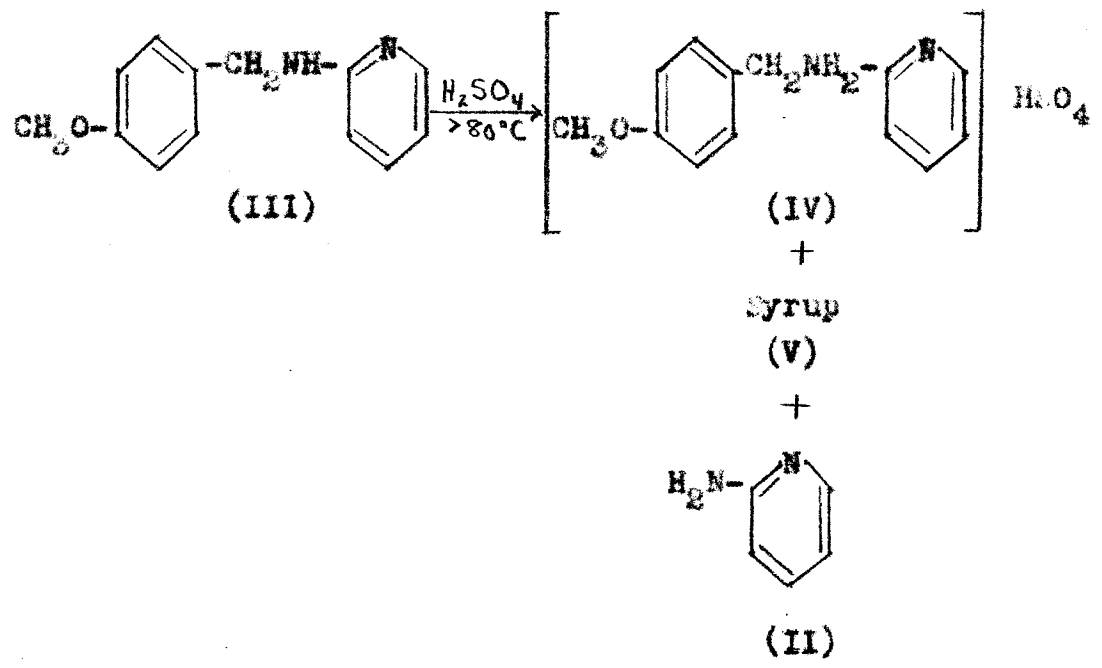


However, in several purifications, yields were found to be comparatively poor with losses up to 20% encountered. These runs were characterized by prolonged contact with the sulfuric acid at temperatures above  $80^{\circ}\text{C}$  and by the production of the viscous syrup (V) <sup>5,6</sup> in addition to the acid salt. Isolation of the syrup showed it to be an amorphous, golden colored material.



An experiment was set up where production of the syrup rather than that of N-(4-methoxybenzyl)pyridine was of primary concern. The quantities of reagents were those of the previously run reaction, but the

sulfuric acid contact time was prolonged from the usual several minutes to six hours and the temperature was raised above 80°C to a 85-95°C range. This was done in an effort to gauge the total effect of the acid upon the base. Syrup(V) yields of 52%-67% were obtained. An aqueous layer, separated from the syrup, was found to contain a very small amount of 2-aminopyridine(II) and the remainder of sulfuric acid salt(IV).



Utilizing the procedures suggested in several texts,<sup>6, 7, 8, 9</sup> numerous attempts were made to identify the syrup(V); these managed to offer very little information toward a solution.

The syrup, as previously noted, was a non-crystalline, semi-fluid, golden substance, exhibiting fluid properties

at room temperature and above, and hardening to the point of brittleness at lower temperatures. Molecular weights between 650-900 were obtained by the Rast method.<sup>6</sup>

The substance was slightly soluble in most organic solvents, being especially soluble in the halogenated hydrocarbons. It was insoluble in water and poorly soluble in alcohols. Solubility was also observed in several acids, acetic, phosphoric and sulfuric in particular, in the latter with the presence of a deep red color. Dilution of the sulfuric acid solution did not reprecipitate the syrup, and attempts to separate out a product from the solution met with no success.

Reaction with numerous characterizing reagents was exceptionally poor. The substance contained nitrogen, carbon, hydrogen, oxygen and the methoxy group. Bromine in carbon tetrachloride reacted with the material to produce a deep yellow syrup. A crystalline product did not materialize from this reaction. Reactions involving potassium permanganate, chromic acid, alcoholic potassium hydroxide, concentrated hydrochloric acid, zinc and hydrochloric acid, either charred the syrup or left it apparently unchanged. A dichromate oxidation, carried out in an aqueous sulfate-bisulfate buffer,<sup>10</sup> however, gave as reaction products, a reddish-brown resinous material and a liquid aldehyde. The aldehyde was characterized

as *p*-methoxybenzaldehyde by formation of a 2,4-dinitro-phenylhydrazone, m.p. (obs.) 248-250°C, (lit.) 253°C.<sup>11</sup>

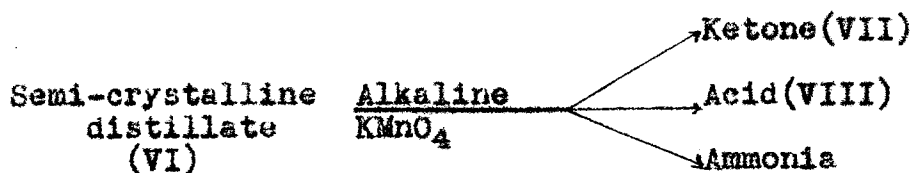
The resinous material was not further identified.

Distillation of the substance, at atmospheric pressure, yielded very little product over a range 70-200°C, and the distillate appeared to be made up of a variety of tar-like odoriferous materials. There was no sign of any material coming off at a constant boiling point. The residue in the distilling flask was a black amorphous mass.

A distillation, under vacuum and a nitrogen atmosphere, however, did afford a product which was able to be further studied. This product, distilling between 195-225°C with a vacuum of 5-10 mm., solidified in the condenser as a yellow, semi-crystalline mass(VI). The yield was about 35%.

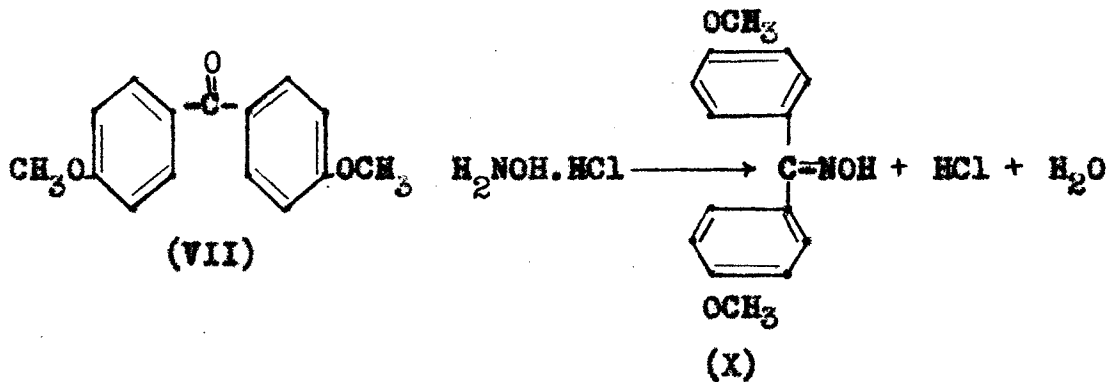
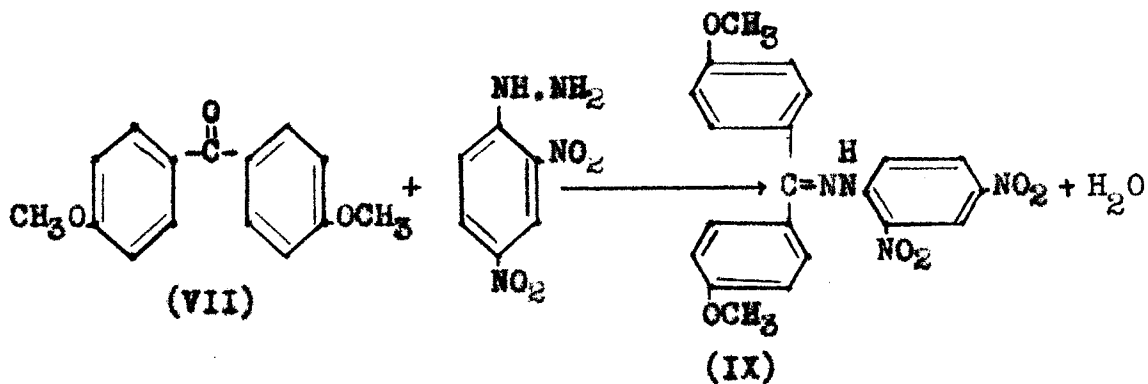
Elemental analysis showed the material to contain carbon, hydrogen, oxygen and nitrogen. It was soluble in many of the organic solvents, but only partially soluble in petroleum ether. Characterization tests showed the substance to contain the methoxy group and the carbonyl group. A melting point determination was not possible since the substance was semi-crystalline.

A portion of the entire mass was subjected to an alkaline potassium permanganate oxidation. This yielded two substances, one a solid ketone(VII), yield 80%, and the other a solid acid(VIII), yield .5%. Ammonia was given off during the reaction.



The carbonyl was characterized through its reaction with 2,4-dinitrophenylhydrazine, and was found to contain carbon, hydrogen, oxygen and the methoxy group. It melted at 143-144° C. A 2,4-dinitrophenylhydrazine derivative(IX) melted at 194-197° C, while an oxime(X) melted at 132-134° C. This data, in addition to a carbon, hydrogen analysis and the results of an infra-red analysis, identified this compound as 4,4'-dimethoxybenzophenone(VII),  
 m.p. (lit.) 143-144° C; <sup>12,13,14</sup> 2,4-dinitrophenylhydrazone  
 (IX), m.p. (lit.) 197° C; <sup>15,16</sup> oxime(X), m.p. (lit.)  
<sup>17,18</sup> 133° C.

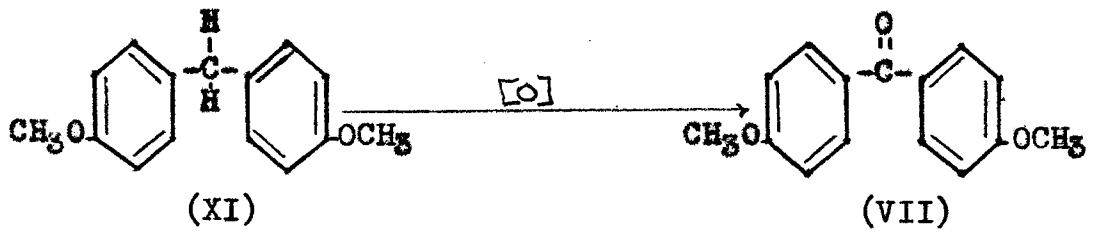
An empirical formula (C<sub>5.03</sub>H<sub>5.05</sub>O)<sub>n</sub> and a molecular weight of 263 were obtained for the ketone. A permanganate oxidation left it unchanged.



The acid was characterized by its reaction with sodium hydroxide and sodium bicarbonate. It contained carbon, hydrogen, oxygen and the methoxy group. A melting point range of 160-167°C was obtained, and the solid remained in this range after repeated attempts at separation and purification. It was soluble in concentrated sulfuric acid with a yellow color. An attempt to form an amide was unsuccessful. From a carbon, hydrogen analysis, the empirical formula  $(C_{3.28}H_{2.79}O)_n$  was

proposed. A molecular weight of 326 was obtained, but in contrast, a neutralization equivalent of 208 was also obtained. This acid substance may be an impure, inseparable mixture.

The above results indicated that the distilled material(VI) was a mixture, and an endeavor was made to separate the components. A portion of the distillate was found to be extractable with petroleum ether. This was a white, crystalline mass of platlets(XI), found to contain carbon, hydrogen, oxygen and the methoxy group. It was soluble in many of the organic solvents, as well as in glacial acetic acid and concentrated sulfuric acid, in the latter with a red color. The melting point was found to be 45-47°C. The carbon, hydrogen and oxygen analysis enabled an empirical formula  $(C_{7.17}H_{7.72}O)_n$  to be obtained. A molecular weight of 254 was determined. Oxidation of this substance yielded 4,4'-dimethoxybenzophenone(VII), about 95%. All the evidence collected appeared to indicate that this oxidized compound was 4,4'-dimethoxydiphenylmethane(XI), m.p. (lit.) 51°C; 19,20,21 48-9°C.



The residue from the petroleum ether extraction appeared as a tan crystalline substance. It contained carbon, hydrogen, oxygen, nitrogen and the methoxy group. Repeated charcoal treatments and recrystallizations from ethanol produced a glistening white compound, melting at 142-145° C. No acidic product was isolated. Characterization tests showed the carbonyl group to be present and a 2,4-dinitrophenylhydrazone was prepared. The derivative gave a melting point of 194-197° C. The properties of this compound conformed to those of 4,4'-dimethoxybenzophenone(VII).

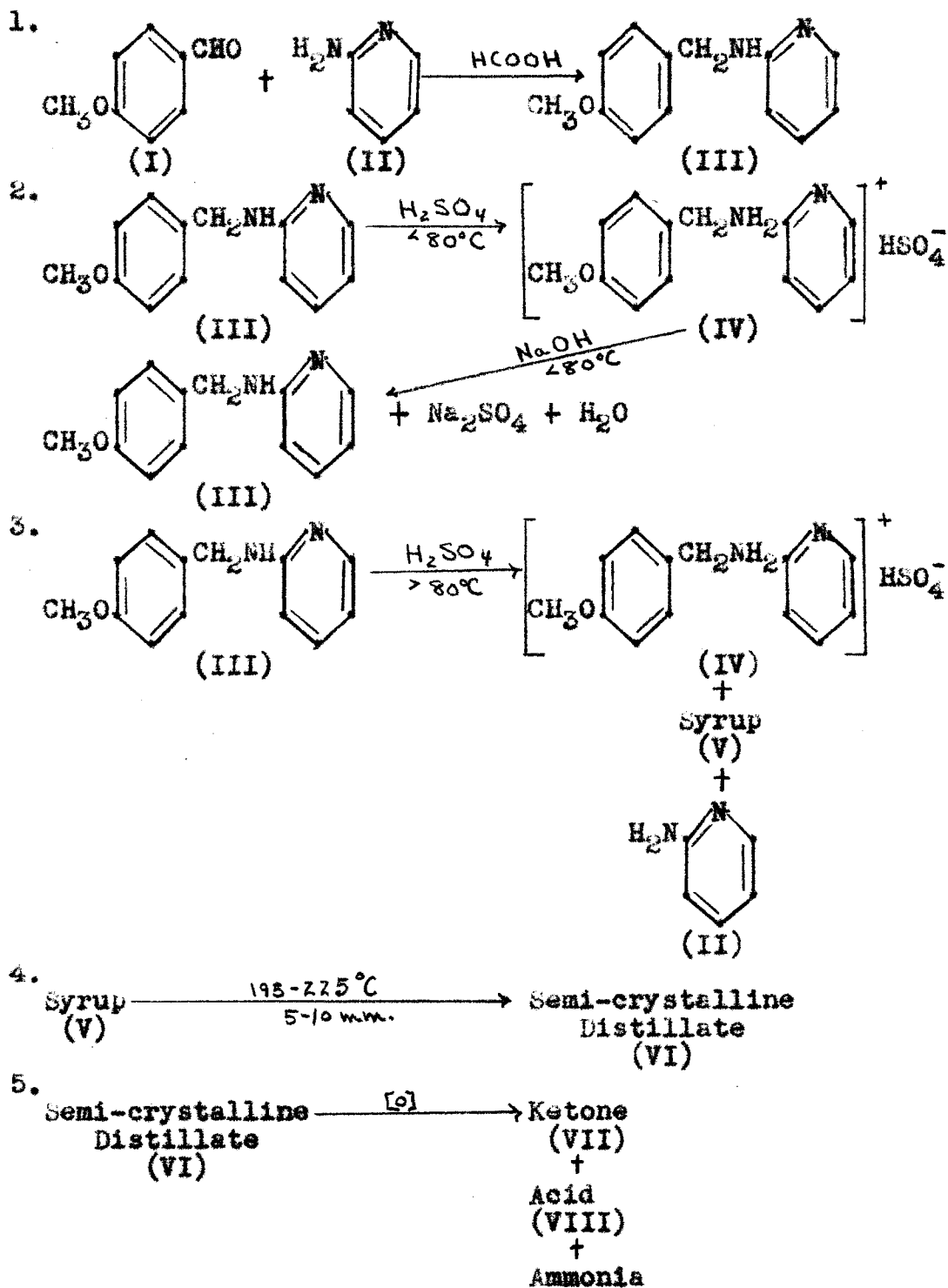
The residue left in the distilling flask was taken up in chloroform, treated with charcoal several times and filtered. On removal of the solvent, a white solid was isolated, m.p. 45-47° C. About 10% was separated from the tar in the flask. Oxidation yielded a ketone, m.p. 142-144° C; 2,4-dinitrophenylhydrazone 192-196° C. The low melting substance was apparently 4,4'-dimethoxydiphenylmethane(XI).

The distilled mixture(VI), in the light of the above information, appears to have been made up of the following, 4,4'-dimethoxybenzophenone(VII), 4,4'-dimethoxydiphenylmethane(XI), and at least one nitrogen compound (XII).



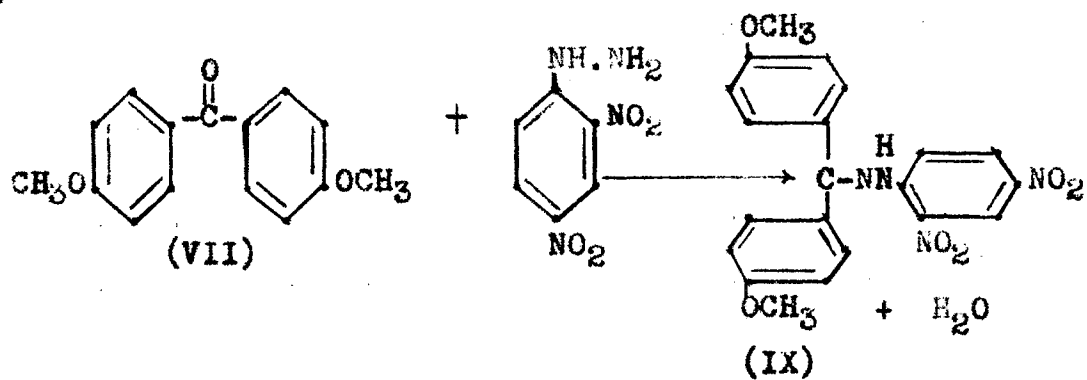
Oxidation of the mixture produced both unchanged 4,4'-dimethoxybenzophenone(VII) and that converted from the distilled 4,4'-dimethoxydiphenylmethane(XI). The acidic material(VIII) in all probability is a result of the oxidation of the nitrogen component(XII).

SUMMARY OF REACTIONS

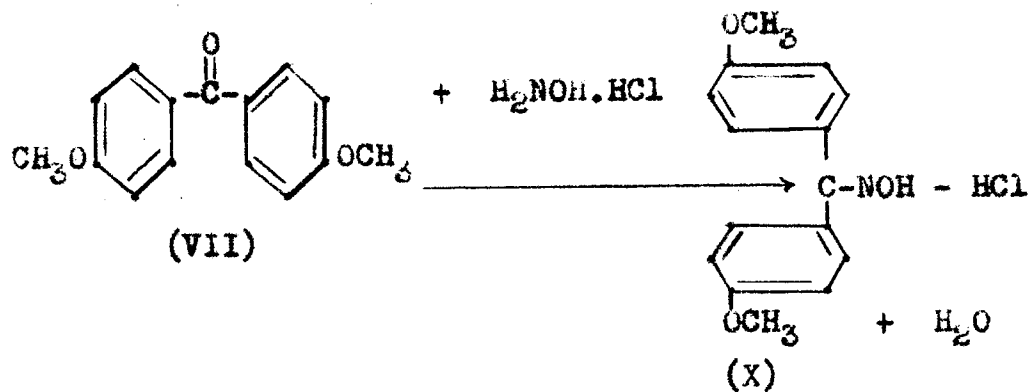


SUMMARY OF REACTIONS

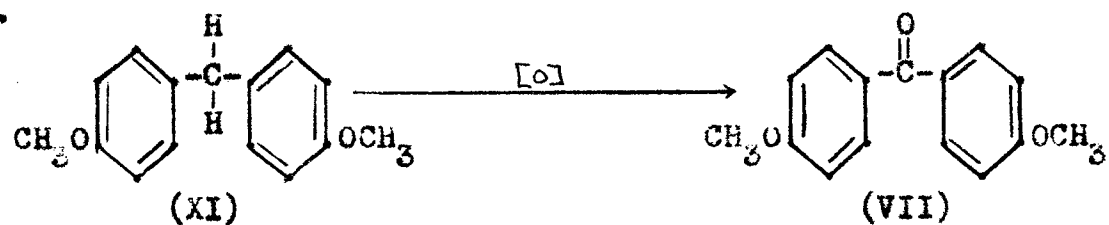
6.



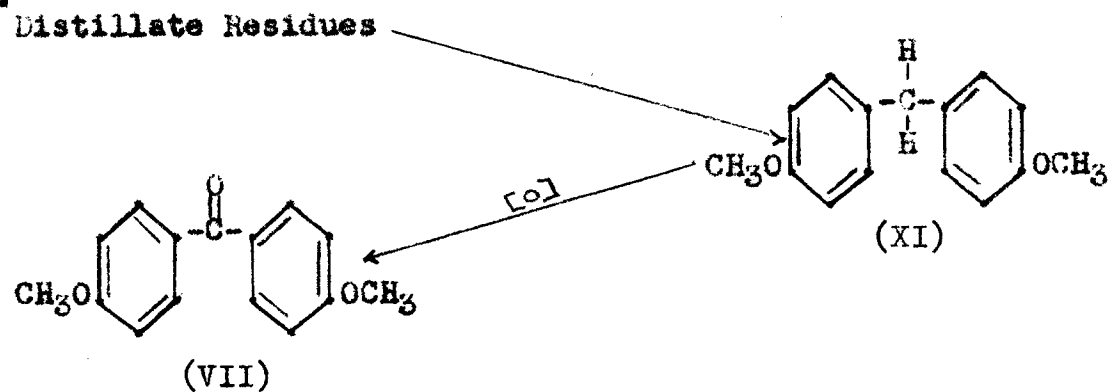
7.



8.



9.



EXPERIMENTAL PROCEDUREPreparation Of 2-(4-methoxybenzylamino)-pyridine(III)<sup>1,2</sup>

Into a three neck, 500 ml. round bottom flask, equipped with a stirrer, thermometer, reflux condenser and dropping funnel, 38.4 ml. of p-methoxybenzaldehyde(I) and 30.0 gms. of 2-aminopyridine(II) were placed. These were heated to 125° C, and 80.0 ml. of 85% formic acid were added over the period of an hour to the melt in the flask. The mixture was refluxed for an hour after the acid addition.

The reflux condenser was replaced with a distillation condenser and water plus formic acid were distilled off, preferably under vacuum.

The reaction mixture was allowed to cool to about 100° C, and a mixture of 154 ml. of water and 23.0 ml. of concentrated sulfuric acid were added. The base was allowed to pass into solution with the temperature kept below 80° C.

The mixture was washed with toluene to remove the unreacted components, and the acid layer cut into a one liter, three neck flask, fitted with a stirrer and thermometer. To this were added 300 ml. of toluene. Maintaining the temperature below 80° C, 30% alkali was slowly added until the mixture became alkaline.

The caustic layer was separated from the solvent layer, which was allowed to cool for several hours. This crystallized material was filtered, oven dried, and re-crystallized from toluene several times. The melting point range was between 122-124° C. The yield of product was 54.8 gms., approximately 80% based on the charge of 2-aminopyridine(II).

Preparation Of The 2-(4-methoxybenzylamino)-pyridine  
3,5  
Degradation Product(V)

Into a three neck, 500 ml., round bottom flask, equipped with a thermometer and condenser, were charged 48.2 gms. of 2-(4-methoxybenzylamino)-pyridine(III), and 14.5 ml. of concentrated sulfuric acid diluted with 96.5 ml. of water.

The resultant solution was refluxed for six hours between 85-95° C, then allowed to cool. Two layers were seen to be present, a straw colored, dense lower one and a light, cloudy upper solution.

Added to the flask were 100 ml. of chloroform, and the entire contents placed in a separatory funnel. The chloroform layer was cut, washed with a 5% sodium hydroxide solution, washed with a 5% hydrochloric acid solution, and then followed with several washes of distilled water. The chloroform solution was concentrated to give a solvent-

free, viscous, yellow syrup weighing 23.6 gms. This product represented a conversion of approximately 67% of the 2-(4-methoxybenzylamino)-pyridine(III). Subsequent runs gave conversions varying from 51% to 67%.

The sodium hydroxide extract was rendered acidic, and extracted with 25 ml. portions of ether. The ether extracts were taken down to dryness with no residue being found.

The hydrochloric acid extract was rendered basic, and a solid separated out. This solid was collected, dried, and found to be unreacted 2-(4-methoxybenzylamino)-pyridine(III). About .5 gm. was collected.

The acid layer separated from the reaction mixture was washed with toluene and made alkaline. Evaporation of the toluene left no residue. The alkaline solution gave forth a precipitate which was collected, dried, and found to be unreacted 2-(4-methoxybenzylamino)-pyridine(III); this amounted to 9.7 gms. A total of 10.2 gms. of this compound remained unreacted, approximately 23%. Several runs gave various amounts, ranging from about 23% to 37%.

A steam distillation of the alkaline solution on one run offered a water soluble amine with a pyridine odor.

Identification of this compound as 2-aminopyridine(II) was made through its melting point 53-55° C, (lit.) 56° C.<sup>22</sup>

About .5 gm. was isolated.

#### Characterization Of The Syrup(V)

The syrup has been previously described as to physical appearances. It was found to be insoluble in water and the alcohols, but quite soluble in the halogenated hydrocarbons, benzene and its homologues, and in concentrated sulfuric acid with a deep red color. It was also soluble in glacial acetic acid, phosphoric acid and nitric acid upon heating. Dilution of the sulfuric acid solution did not precipitate out any product, nor did neutralization. All attempts to extract and isolate the sulfuric acid reaction product failed. A sulfonation is quite likely here.

The syrup was viscous, but with temperature of 30°C and above it became quite fluid. Cooling it in ice made it hard and brittle. At room temperature it was able to be drawn into thread-like strands. However, all attempts at crystallization utilizing many solvents, solvent pairs, and techniques failed.

Characterization tests were run, following the procedures found in several texts.<sup>6,7,8,9</sup> These did not offer many substantial clues. Nitrogen was found. The presence

of a methoxy group or groups was determined through the Zeisel test.<sup>6</sup> The syrup was found to readily react with bromine in carbon tetrachloride, giving a yellow, gum-like material which did not crystallize. A Rast method<sup>6</sup> molecular weight determination gave molecular weights ranging from 650-950.

An alkaline potassium permanganate oxidation of the substance did not appear to offer any sign of a reaction, as did refluxing with concentrated hydrochloric acid, zinc and hydrochloric acid, and alcoholic potassium hydroxide. Oxidation with chromic acid rapidly charred the substance and turned it into tar-like mass. The odor of p-methoxybenzaldehyde(I) was obvious during the reaction.

An oxidation of the syrup by dichromate in a sulfate-bisulfate buffer<sup>10</sup> was tried. Into a 500 ml., round bottom flask, equipped with a condenser, 6 gms. of sample were charged. To this were added 20 ml. of water, 20 ml. of 2M sulfuric acid, 45 ml. of sodium sulfate and 40 ml. of dichromic acid reagent, 10 gms. of chromium trioxide diluted to 100 ml. with 1.5M sulfuric acid. The reaction mixture was refluxed gently for one half hour, during which time its color changed from orange-brown to green. The syrup, clinging to the flask's sides, changed in color from yellow to a brown.



A cooled solution was heated until distillation took place. Water, smelling strongly of anise, distilled off during a two hour period. The aqueous distillate was extracted twice with 50 ml. portions of chloroform. This solution was concentrated yielding about .8 gm. of an oil bearing the odor of anise.

The oil was characterized as *p*-methoxybenzaldehyde(I) by its reaction with 2,4-dinitrophenylhydrazine producing the derivative melting at 248-250° C, (lit.) 253° C.<sup>11</sup>

A distillation of 20 gms. of the syrup, at atmospheric pressure produced only a few grams of tar-like materials, having extremely offensive odors; the odor of ammonia was prevalent throughout most of the distillation which took place between 70-200° C. None of the materials came off at any particular boiling point.

Isolation Of 4,4'-dimethoxybenzophenone(VII)<sup>12,13,14</sup> And  
4,4'-dimethoxydiphenylmethane(XI)<sup>19,20,21</sup> From The Syrup(V)

From 28.6 gms. of syrup(V), about 10 gms. of a yellow substance were distilled under vacuum and nitrogen. This distilled over between 195-225° C and 5-10 mm. of vacuum. It solidified in the condenser, but on removal appeared to be semi-crystalline.

This material(VI) contained nitrogen, in addition to

carbon, hydrogen and oxygen. It was soluble in cold chloroform and warm ether, petroleum ether, ethyl alcohol, acetone and methyl alcohol, but insoluble in water. Characterization tests showed this compound to respond to that for the carbonyl and methoxy groups.

About 5 gms. of the distilled substance(VI) was taken up in 100 ml. of hot petroleum ether. On cooling, a small amount of light brown crystals was filtered and dried, weight about .8 gm. This material contained carbon, hydrogen, oxygen and nitrogen. A melting point was extremely indistinct. The crystals were dissolved in a small amount of chloroform and treated with charcoal. The solvent was driven off producing about .5 gm. of white crystals. These melted at 142-145° C. Nitrogen was not present. A positive reaction with 2,4-dinitrophenylhydrazine and the derivative prepared, melting at 194-197° C, indicated 4,4'-dimethoxybenzophenone(VII).

The petroleum ether was removed from the filtrate producing about 4 gms. of white platlets melting at 45-47° C. Nitrogen was not found, but the methoxy group was present. It developed a deep red color in concentrated sulfuric acid. It was soluble in ether, petroleum ether, chloroform, acetone, methyl alcohol, ethyl alcohol and glacial acetic acid. Recrystallizations from a water-

methyl alcohol solvent pair produced excellent results.

A molecular weight of 254 was determined. The carbon content was found to be 78.41%, the hydrogen content 7.03%, and the oxygen content calculated to be 14.56%. As a result, the empirical formula  $(C_{7.17}H_{7.72}O)_n$  was proposed. All the data seemed to indicate that the structure was 4,4'-dimethoxydiphenylmethane(XI),  $C_{15}H_{16}O_2$ , m.p. (lit.)<sup>19,20,21</sup> 51 C; 48-49 C; 4,4',4''-trimethoxytriphenylmethane,  $C_{22}H_{22}O_3$ , m.p. (lit.)<sup>23,24</sup> 48-49 C; 51-52 C or even a mixture.

Subsequent study in the form of a permanganate oxidation of the substance points to 4,4'-dimethoxydiphenylmethane(XI),  $C_{15}H_{16}O_2$ . In this reaction the only product isolated and identified was 4,4'-dimethoxybenzophenone(VII).

Preparation Of 4,4'-dimethoxybenzophenone(VII)<sup>12,13,14</sup>  
From 4,4'-dimethoxydiphenylmethane(XI)<sup>19,20,21</sup>

A gram of 4,4'-dimethoxybenzophenone(VII) was added to 80 ml. of water containing 4 gms. of potassium permanganate. To this was added 1 ml. of 10% sodium hydroxide solution, and the mixture was refluxed for two hours at which time the purple color disappeared. The mixture was allowed to cool and a quantity of white crystals was seen to be floating on its surface. The crystals and manganese dioxide were filtered free of so-

lution. The white crystals were extracted with chloroform and the chloroform stripped off. The resultant white crystals, about 1 gm., melted at 143-144° C. This represented a yield of about 95%. The methoxy group was present and a positive reaction was observed with 2,4-dinitrophenylhydrazine. The 2,4-dinitrophenylhydrazone melted at 194-197° C.

A carbon content of 74.07%, a hydrogen content of 6.21% and an oxygen content of 19.72% were determined, thus proposing the empirical formula  $(C_{5.03}H_{5.05}O)_n$ . A molecular weight of 263 was obtained. An oxime was prepared melting at 132-134° C. All information indicated the compound to be 4,4'-dimethoxybenzophenone(VII),  $C_{15}H_{14}O_3$ .

The filtrate was acidified with sulfuric acid, heated for one half hour and cooled. There was no precipitate.

12,13,14

Preparation Of 4,4'-dimethoxybenzophenone(VII) And  
An Acidic Unknown(VIII) From The Distilled Mixture(VI)

It was assumed at first that the distillation product(VI) was one material, and an attempt was made to oxidize it.

An alkaline permanganate oxidation was run. To a 250 ml. round bottom flask, 2.5 gms. of the unknown, 8 gms.

of potassium permanganate, 160 ml. of water and 2 ml. of 10% sodium hydroxide were added. The mixture was refluxed until the color of the permanganate had disappeared, approximately three hours. The flask contents was allowed to cool, at which time white crystals separated out of the solution. The solution was filtered; manganese dioxide and product were collected. This mixture was treated with 100 ml. of warm chloroform, charcoal treated and then recrystallized several times out of methyl alcohol, yielding beautiful, white, lustrous platlets. Needles crystallized out of chloroform. These melted at 143-144° C and weighed about 1.6 gms., 80% yield. The compound reacted with 2,4-dinitrophenylhydrazine and produced a derivative melting at 194-197° C.

An infra-red analysis showed bands at 6.1, 6.2, 6.3 and 6.62  $\mu$ . An aromatic, or perhaps a heterocyclic functionality was indicated here. A strong band in the 8  $\mu$  suggested a  $\text{C}-\text{OCH}_3$  grouping. NH or OH groups were not present, and a saturated  $\text{C}=\text{O}$  or normal  $\text{C}-\text{C}-\text{C}=\text{O}$  were not indicated. This information was not completely substantiating for a dimethoxy diaryl ketone, but this may be attributed to the nature of the compound.

The melting ranges of the compound and the derivative point to 4,4'-dimethoxybenzophenone(VII) as being

the identity of the compound.

The alkaline filtrate was made acid, heated for about one half hour, cooled, and the separated white crystals filtered. These, about .2 gm., were taken into an alcohol solution, charcoal treated and crystallized several times. The melt of this acid was not very definite for it first sintered in the 150-160° C range, and then melted over the 160-167° C range. Repeated neutralization equivalents varied from values of 206 to 210. A molecular weight of 326 was also obtained.

An empirical formula  $(C_{3.28}H_{2.79}O)_n$  was derived from a carbon content of 67.75%, a hydrogen content of 4.80% and an oxygen content of 27.45%.

The material responded to the methoxy group test, but did not yield an amide which could be isolated. In concentrated sulfuric acid, the compound produced a light yellow color.

An attempt was made to link the ketone(VII) with the acidic material(VIII) through a permanganate oxidation. However, in this reaction the ketone remained unchanged and the permanganate left unreduced even after ten hours of refluxing. Further identification work was not continued.

19,20,21

Isolation Of 4,4'-dimethoxydiphenylmethane(XI)  
From Distillation Residues

After distillation of the semi-crystalline distillate (VI), 200 ml. of chloroform were added to the tar-like residues found in the flask, about 14 gms. of material.

Repeated charcoal treatments and filtrations gave a pale yellow solution. On removal of the solvent, about 1 gm. of a white solid was isolated, m.p. 45-47° C. Oxidation yielded a ketone melting at 142-144° C. The low melting solid was evidently 4,4'-dimethoxydiphenylmethane(XI).

Preparation Of The 2,4-dinitrophenylhydrazone  
 6,15,16  
Derivative(IX) Of 4,4'-dimethoxybenzo-  
 12,13,14  
phenone(VII)

A solution of the carbonyl compound(VII) in ethanol was prepared by dissolving .5 gm. of the compound in 20 ml. of 95% ethanol. A freshly prepared 2,4-dinitrophenylhydrazine solution was added, and the resulting mixture was allowed to stand. Crystallization took place within 10 minutes. The crystals were filtered and then recrystallized from ethanol. The derivative(IX) was filtered, dried and a melting point determined; this was 194-197° C.

The 2,4-dinitrophenylhydrazine solution was prepared

by dissolving about .4 gm. of reagent in 2 ml. of concentrated sulfuric acid in a 25 ml. Erlenmeyer flask. About 3 ml. of water was added until solution was complete. To this warm solution was added 10 ml. of 95% ethanol.

6,17,18

Preparation Of The Oxime(X) Of 4,4'-dimethoxybenzo-  
phenone(VII)  
 12,13,14

A mixture of 1 gm. of the ketone(VII), 1 gm. of hydroxylamine hydrochloride, 4 gms. of potassium hydroxide and 20 ml. of 95% ethanol were refluxed for two hours. It was then poured into 150 ml. of water. The suspension was stirred and allowed to stand to permit unchanged ketone to separate. The solution was filtered, acidified with hydrochloric acid, and allowed to stand. The crystallized oxime(X) was recrystallized from ethanol. The melting point was determined to be 132-134° C.



### CONCLUSION

The failure to identify the product or products(V) resulting from the acid degradation of 2-(4-methoxybenzylamino)-pyridine(III) indicates that a fairly inseparable mixture of compounds or a rather complicated resinous substance is under consideration. The physical and chemical properties of the substance point to the latter possibility.

Of interest was the isolation and identification of the compounds, 4,4'-dimethoxydiphenylmethane(XI) and 4,4'-dimethoxybenzophenone(VII). These were seen to be derived from the by-product(V) of the Leuckart reaction by means of a pyrolysis. The ketone(VII) was also formed by an oxidation of the substituted methane(XI). This provided a second path for its derivation.

The acidic substance(VIII) isolated was originally thought to be derived from either the carbonyl(VII) or the substituted methane(XI). This was not the case since oxidations of both compounds failed to yield the acidic component(VIII). This was apparently derived from the nitrogen containing compound found in the semi-crystalline distillate(VI) obtained from the syrup(V). This nitrogen compound was not isolated and the acidic component(VIII) was not identified.

REFERENCES

1. Viaud, Produits Pharmac. France, 2, p.53, 1947.
2. Boret, Walthert, Ann. Pharm. Franc., 2/4, p.1, 1944.
3. M.L. Moore, Organic Reactions, Vol. V, pp.301-330. New York: John Wiley & Sons, Inc., 1948.
4. Crossley and Moore, Journal of Organic Chemistry, 9, p.529, 1944.
5. Dickison and Ingersoll, Journal of the American Chemical Society, 61, p.2477, 1939.
6. Shriner and Fuson, Identification Of Organic Compounds, Third Edition. New York: John Wiley & Sons, Inc., 1948.
7. W.J. Hickinbottom, Reaction Of Organic Compounds.
8. Schneider, Qualitative Organic Microanalysis. New York: John Wiley & Sons, Inc., 1946.
9. Kamm, Qualitative Organic Analysis.
10. F.W. Neumann and C.W. Gould, Analytical Chemistry, Vol. 25, p.751, 1953.
11. Hopkins & Williams LTD, Organic Reagents For Organic Analysis. Brooklyn: Chemical Publishing Co., Inc., 1946.
12. Beilstein's Handbuch der Organischen Chemie, VIII, p.317; XI8, p.641; XI18, p.355.
13. Berichte der deutschen chemischen Gesellschaft, 14, p.323.
14. Ibid, 28, p.2870.
15. Shoppee, Journal of the Chemical Society, 1936, p.506.
16. Chemical Abstracts, 34, pp.1948-5.
17. Beilstein's Handbuch der Organischen Chemie, VIII, p.318.
18. Schnackenberg and Scholl, Berichte der deutschen chemischen Gesellschaft, 36, p.654.

19. Liebig's Annalen der Chemie, 194, p.323.
20. Ibid, p.334.
21. Beilstein's Handbuch der Organischen Chemie, VI, p.1143; E16, p.564; E116, p.1108.
22. Handbook of Chemistry and Physics, Thirtieth Edition, Cleveland, Ohio: Chemical Rubber Publishing Co., 1947.
23. Berichte der deutschen chemischen Gesellschaft, 35, p.1197.
24. Beilstein's Handbuch der Organischen Chemie, VI, p.995; E116, 964.