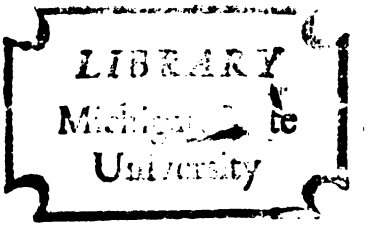
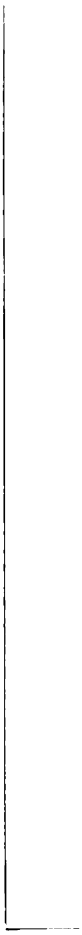
THE CURTIUS AND BECKMANN REARRANGEMENT OF THE 2-THIANAPTHYL SYSTEM

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
Earl D. Mitchell, Jr.
1963





THE CURTIUS AND BECKMANN REARRANGEMENT OF THE 2-THIANAPTHYL SYSTEM

By

Earl D. Mitchell, Jr.

A THESIS

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in partial fulfillment of the requirements
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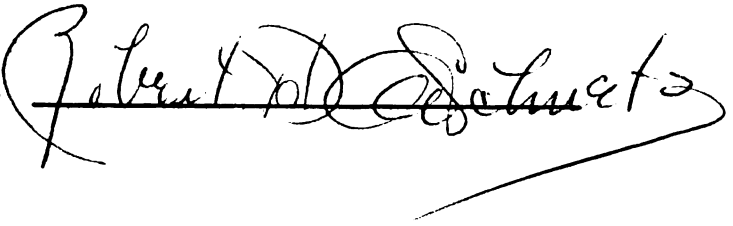
Department of Chemistry

1963

Approved 

ACKNOWLEDGEMENT

The author wishes to express his earnest appreciation to Professor Robert D. Schuetz for his counsel and friendship throughout the course of this work. The author is also grateful to his wife for her support and understanding during the course of this investigation.

TABLE OF CONTENTS

LIST OF FIGURES

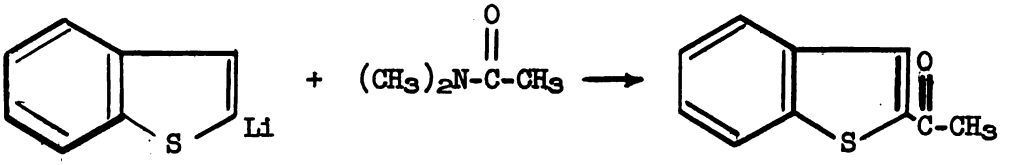
ABSTRACT

THE CURTIUS AND BECKMANN REARRANGEMENT OF THE 2-THIANAPTHYL SYSTEM

by Earl D. Mitchell

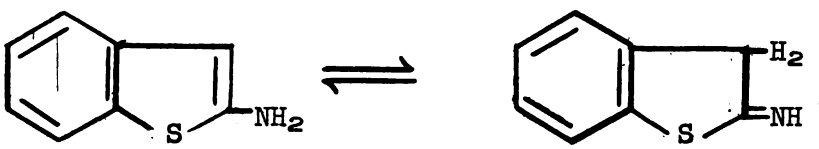
The purpose of this investigation was to develop new synthetic methods to obtain derivatives of 2-amino thianapthene. The procedures used were the Curtius and Beckmann rearrangements.

A new synthetic method was developed for the preparation of the intermediate ketones for the Beckmann rearrangement on the 2-thianapthyl system. The reaction sequence can be illustrated by the following equations.



INTRODUCTION

The present study was undertaken to develop synthetic methods to obtain derivatives of 2-aminothianapthenes through nitrogen to carbon rearrangement reactions. There have been a few reports in the literature on 3-aminothianapthene[1]. 2-Aminothianapthene is unknown and 3-aminothianapthene is reported[2] to be too unstable to be isolated. It is apparently less stable than 2- and 3-aminothiophene, since it has been reported[3] that 2- and 3-aminothiophenes are undistillable. The instability of the 2- and 3-aminothianapthenes is very probably due to the existence of the amino form and the



tautomeric imino form, in which the latter contributes greatly to its instability.

Stable aminothiophenes are obtained[4] in the form of derivatives. These derivatives are usually obtained via the Curtius, Beckmann, and Hoffmann rearrangements. Based on this observation and the similarity in the chemistry of thiophene and thianapthene, it was reasonable to anticipate that stable aminothianapthenes could be obtained in the form of derivatives,

through the use of the Curtius, Beckmann, and Hoffman rearrangement of appropriate nitrogen containing compounds of thianapthene. The Hoffmann rearrangement has been extensively studied on the 2- and 3-thianapthyl system[5]. The Curtius rearrangement has been partially examined[5], but at present the Beckmann rearrangement has not been reported. The initial problem in connection with a study of the Beckmann rearrangement in the thianapthyl system is obtaining the intermediate ketones. Previously reported methods for the preparation[6] of 2-thianapthene ketones usually had limited applicability and did not, in general give satisfactory yields of these compounds. It was hoped that a simpler and more easily applied method giving better yields of pure product could be developed. In the course of this investigation a satisfactory general procedure has been developed to obtain acyl derivatives of thianapthene.

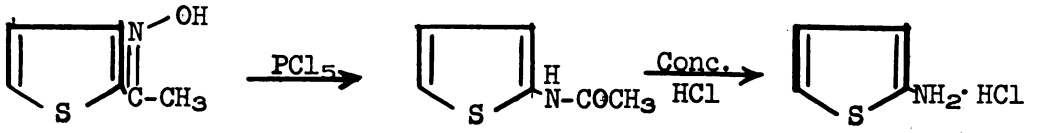
HISTORICAL

While there has been rather extensive studies reported on the 2- and 3-aminothienyl system, relatively few 2- and 3-aminothianapthene derivatives have been prepared up to the present time.

In 1902, Curtius[7] treated 2-thenoyl azide with absolute ethanol at the reflux temperature of ethanol and obtained

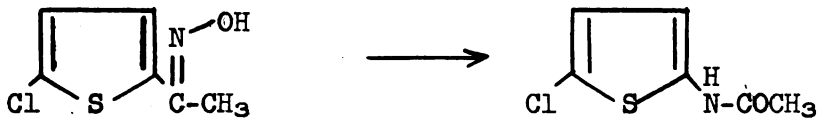
ethyl 2-thienyl carbamate.

However, as early as 1899, Remini[8] carried out the Beckmann rearrangement on methyl 2-thienyl ketoxime to obtain



2-acetyl 2-aminothiophene.

Recently Buzak and Teste[9] have studied the same rearrangement with the 5-chloro-2-thienyl system.



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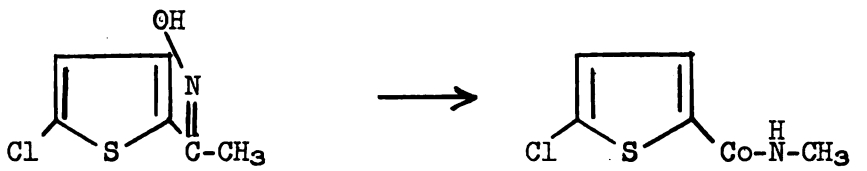

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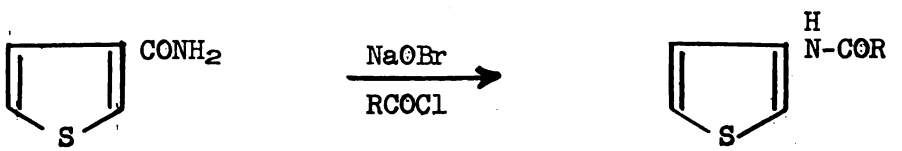
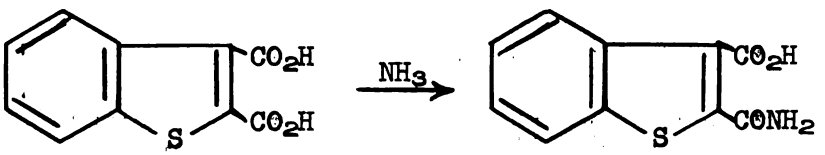
In the 3-thienyl system, Campaigne[10] has investigated the Hoffmann degradation of 3-thienamide and isolated the substituted amide.



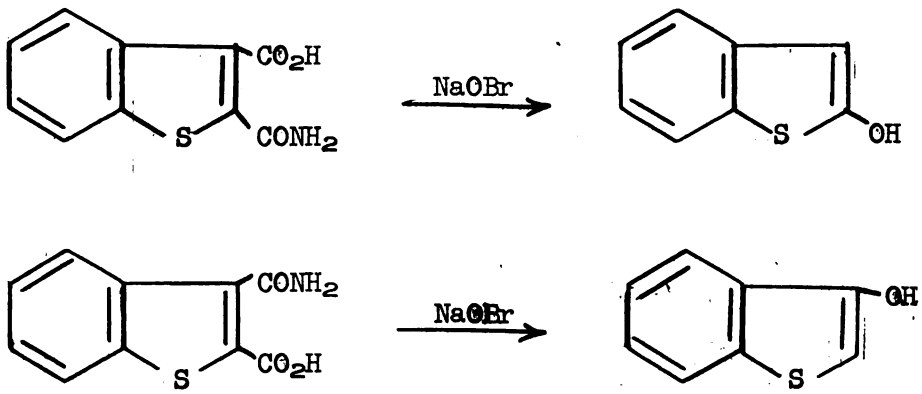
R = Me, ∅

Weissgruber and Kruber[5] reported that 2,3-thianapthene dicarboxylic acid formed two isomeric monamides, when allowed

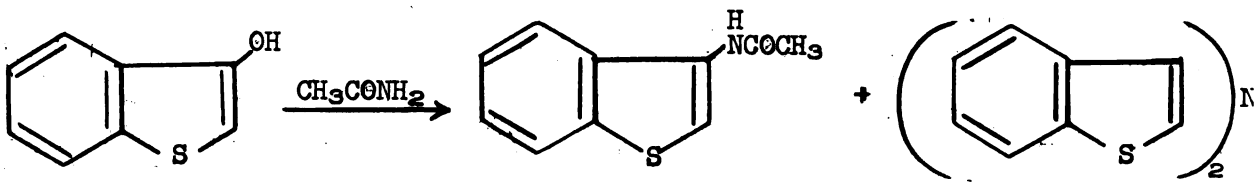


I II

to interact with ammonia. Structures I and II were

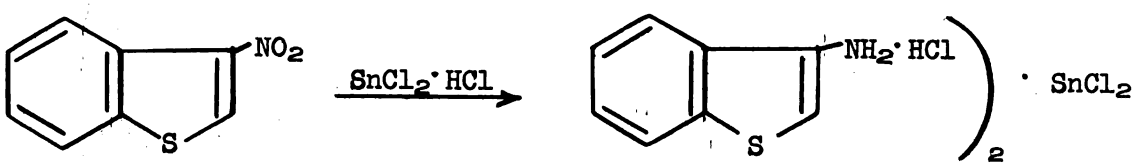


established by the Hoffmann degradation reaction in which the known 2- and 3-hydroxy thianapthenes were obtained. The anticipated product in these Hoffmann degradation reactions would normally be the aminothianapthenes. The isolation of the 2- and 3-hydroxy derivatives clearly demonstrate that the amino group is unstable and is easily replaced by a hydroxyl group. The reaction is reversible since the acetamide derivative is obtained[3] when 3-hydroxy thianapthene is treated with



acetamide in acetic acid; the principle product being di(3-thianapthene)amine(II).

In 1929, Kompa[11] isolated 3-amino thianapthene as its stannic chloride double salt by the reduction of 3-nitro

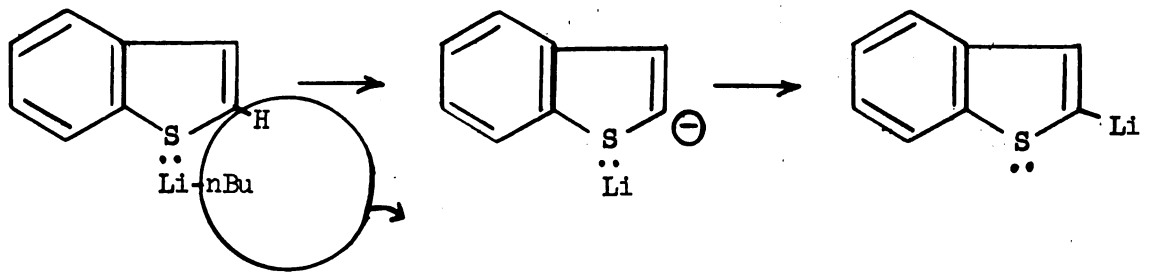


thianapthene with an acid solution of stannous chloride.

The Beckmann rearrangement has not as yet been carried out with the 2- and 3-thianapthyl system, an aim of this study. The present investigation also examined the feasibility of developing a good reaction sequence that, in general, would give good yields of the desired ketones, required for a study of the Beckmann arrangement in such a system.

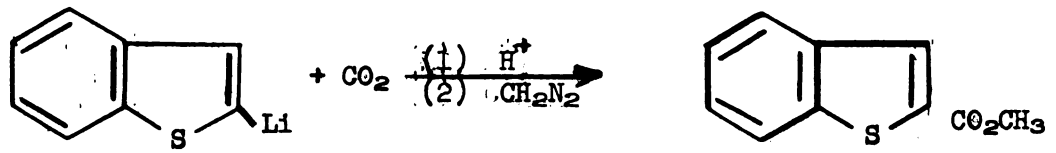
RESULTS AND DISCUSSION

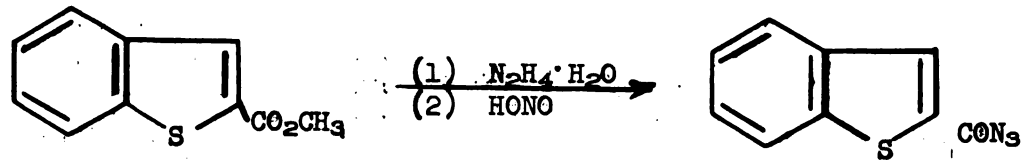
In order to introduce substituent groups in the 2-position on thianapthene, it is first necessary to metalate thianapthene using an exchange reaction with n-butyl lithium[12]. Mono metalation of thianapthene occurs almost exclusively at the 2-position which can be explained by the inductive effect of the hetero atom[13].



THE CURTIUS REARRANGEMENT

The Weissgerber[5] method was used for the preparation of thianapthoyl azide. To obtain quantitative yields of methyl thianapthoate, diazomethane was used. Diazotization





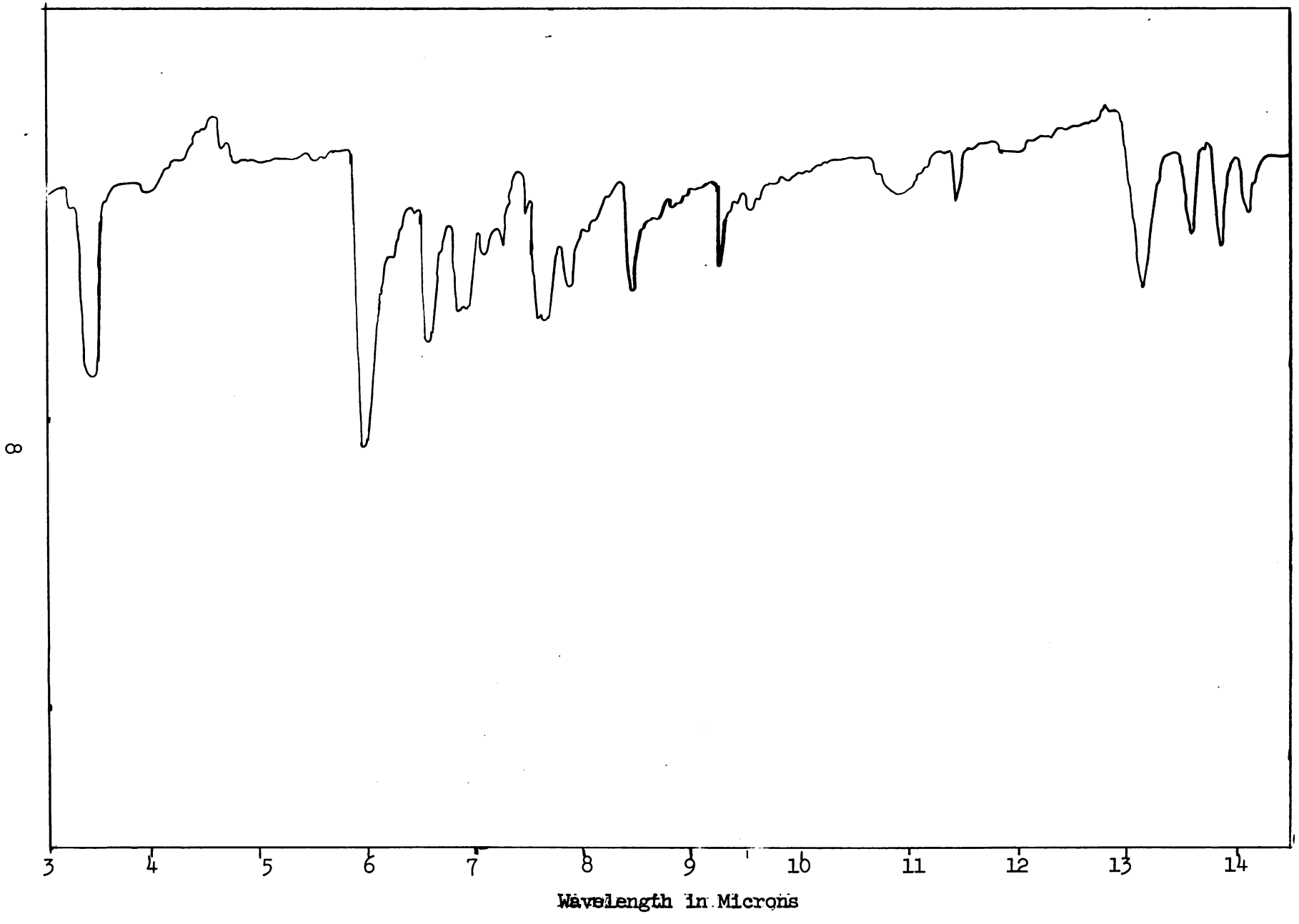


Figure 1. Infrared Spectrum of 2-Thianapthoic Acid.

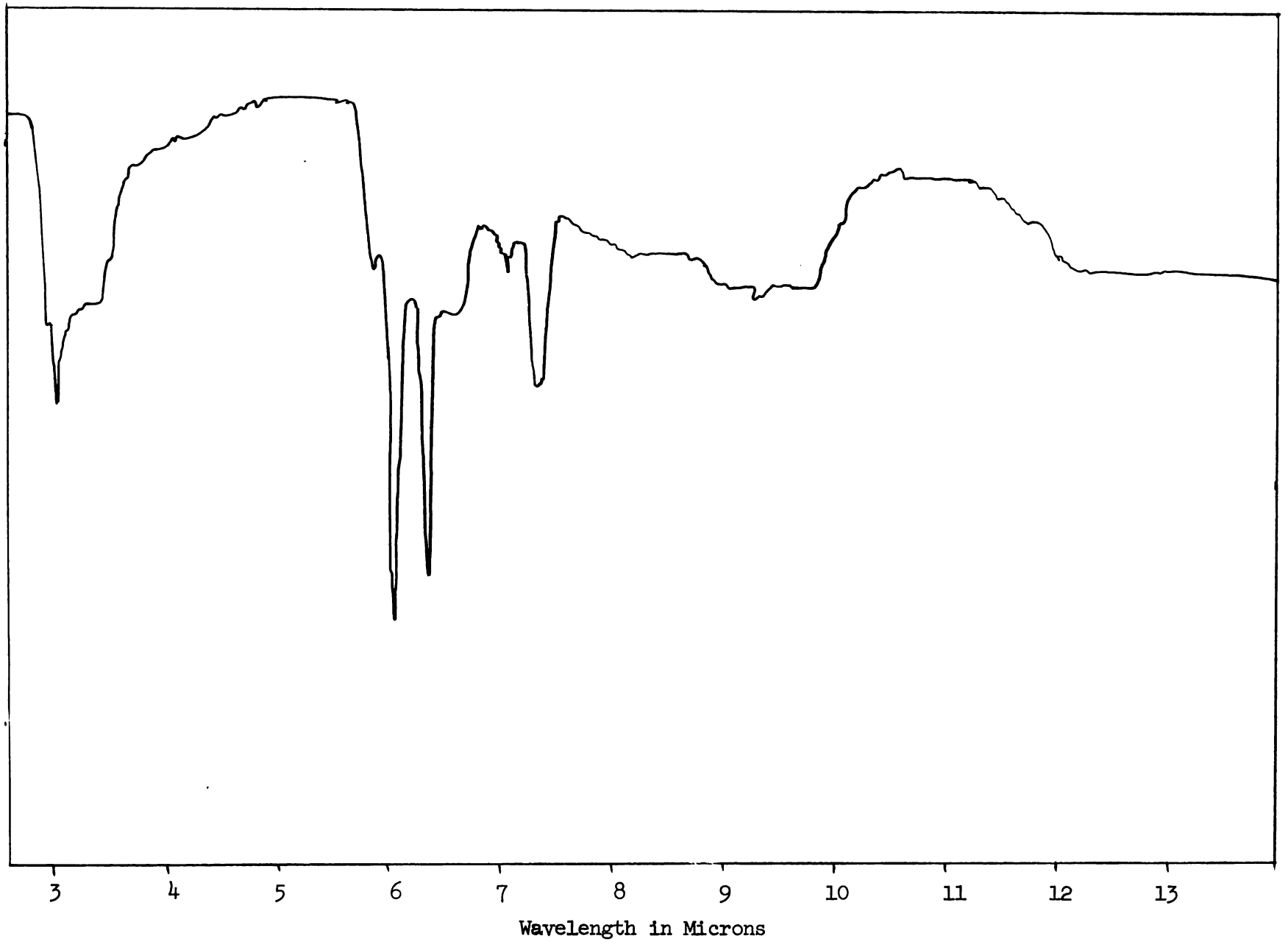


Figure 2. Infrared Spectrum of 2-Thianapthylamide.

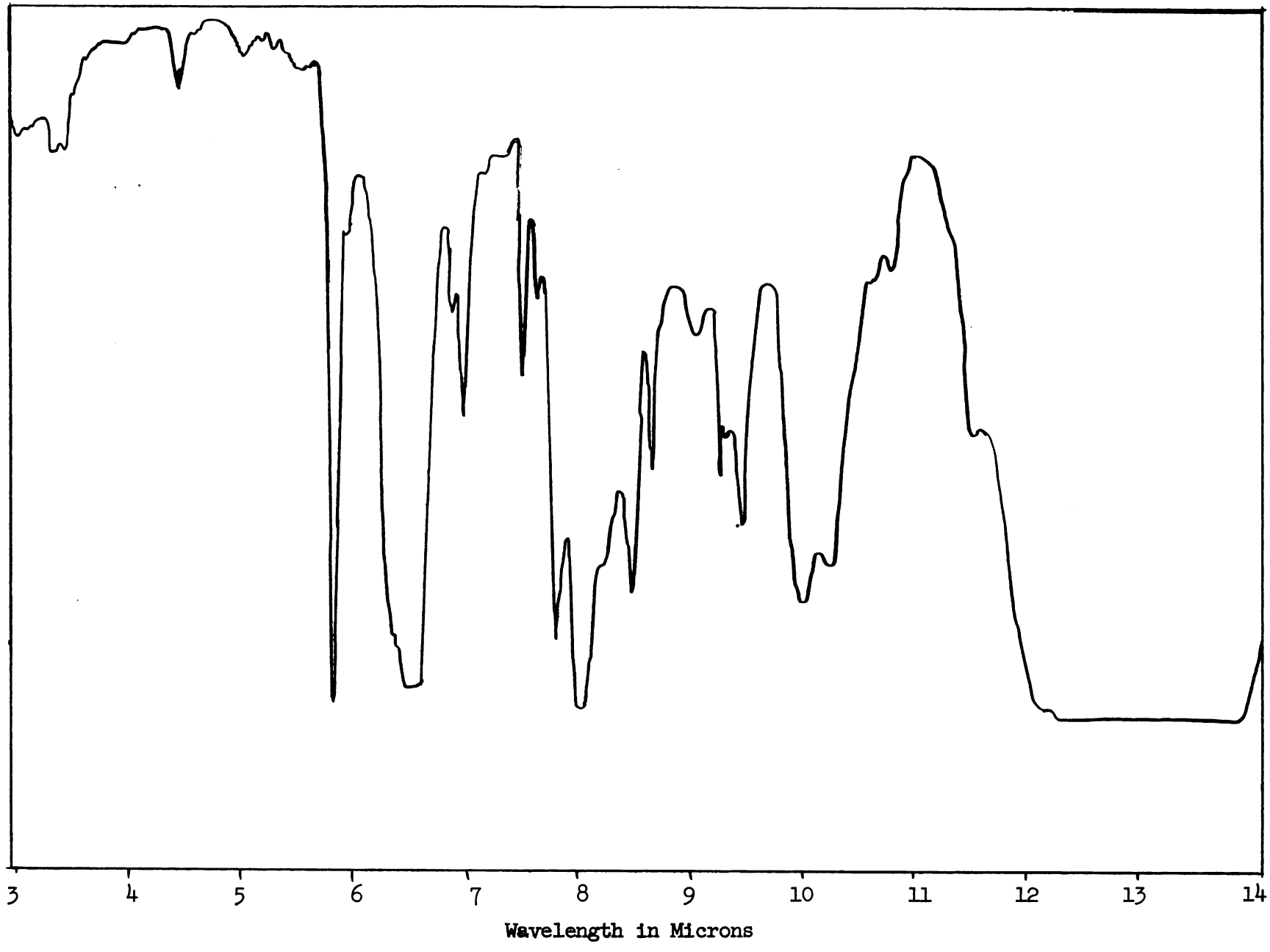


Figure 3. Infrared Spectrum of Methyl 2-Thianapthoate.

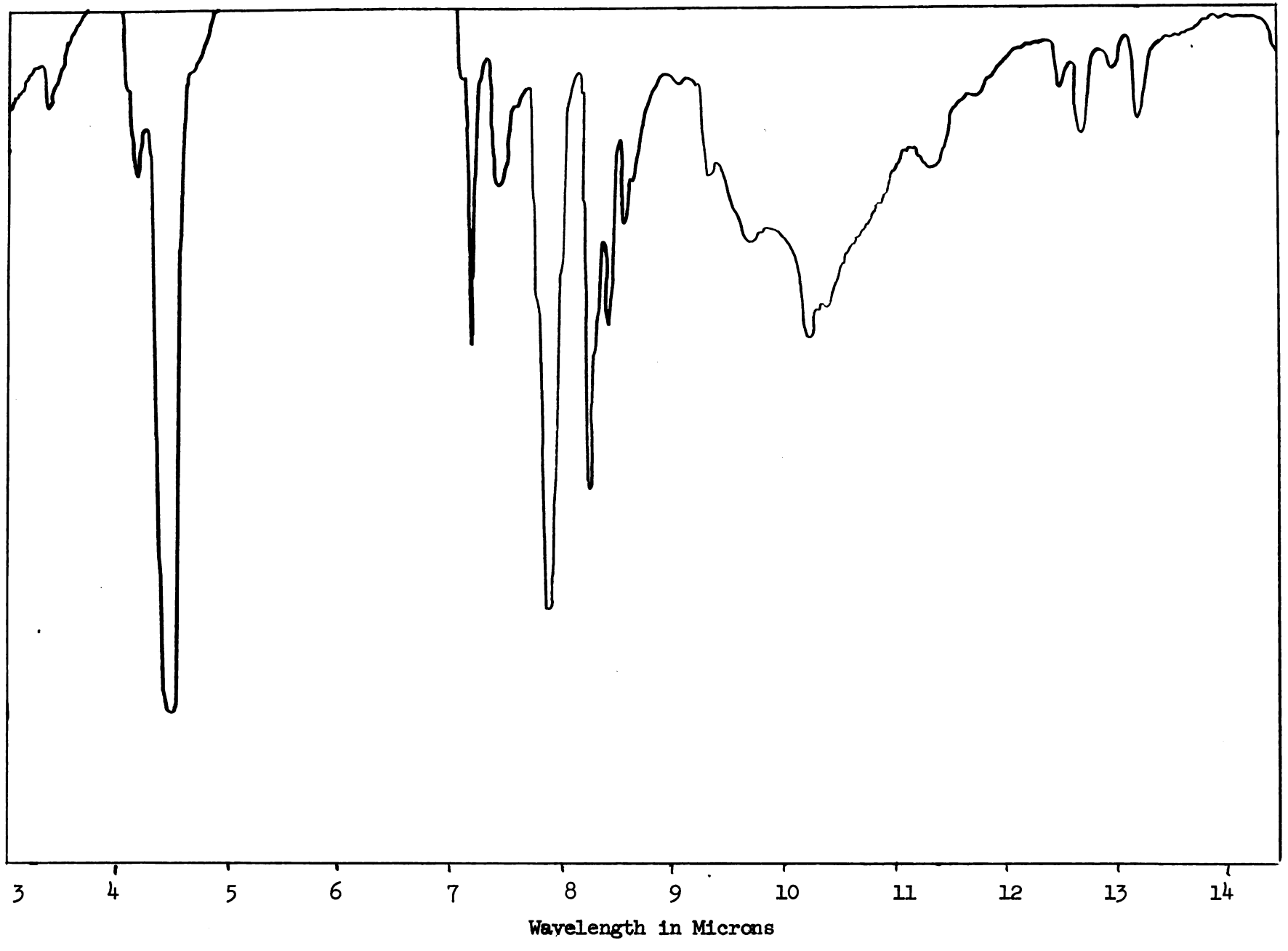


Figure 4. Infrared Spectrum of 2-Thianapthoyl Hydrazide.

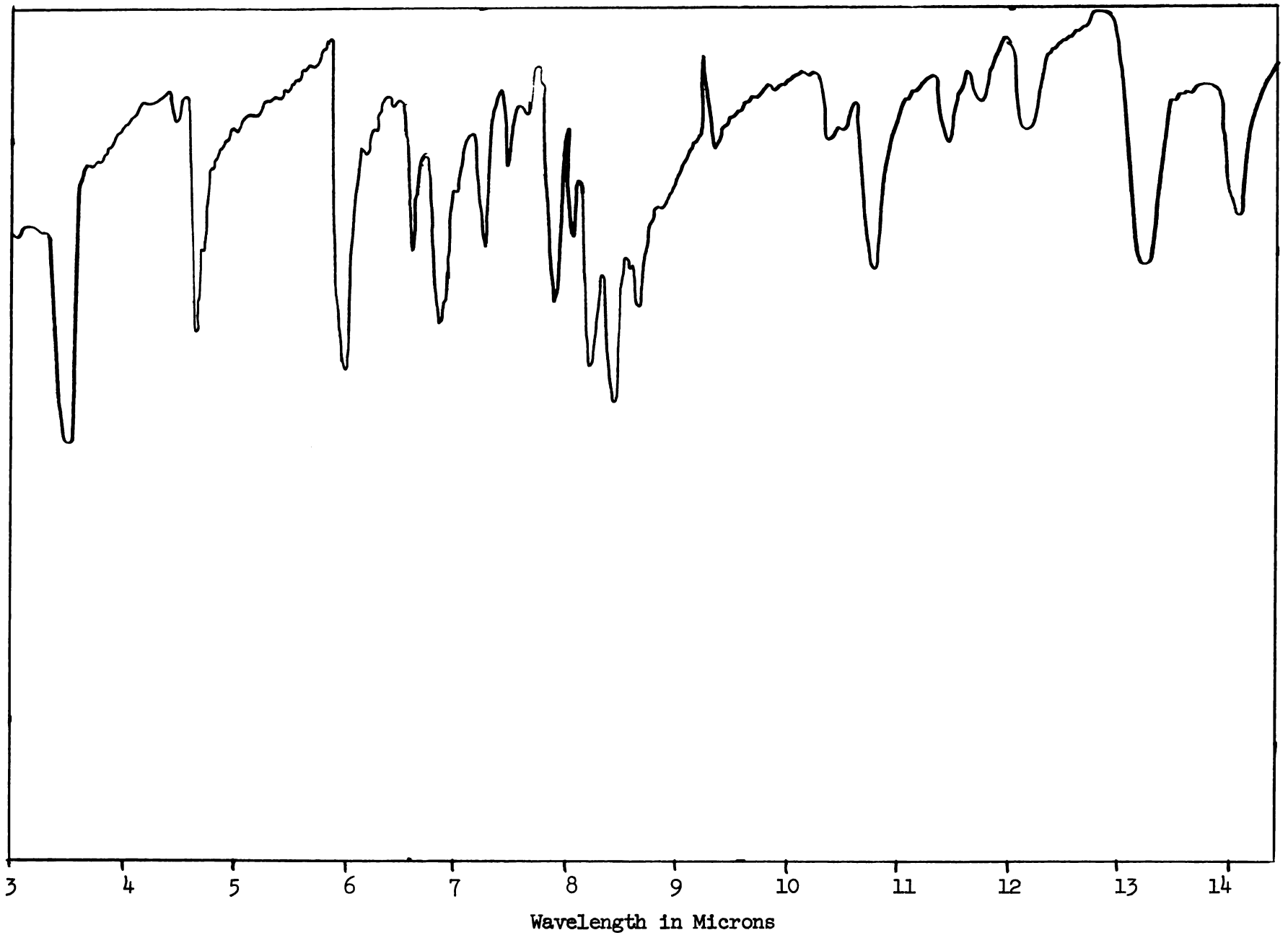
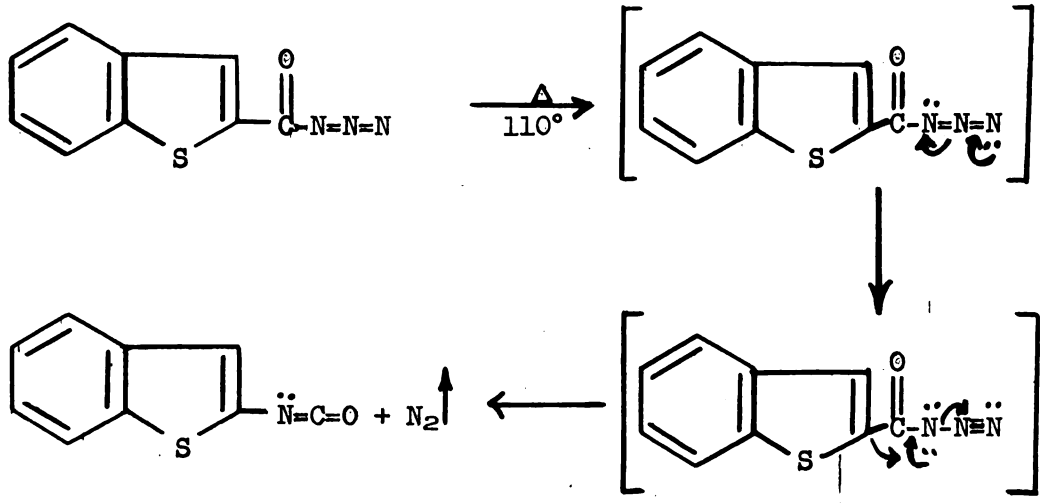


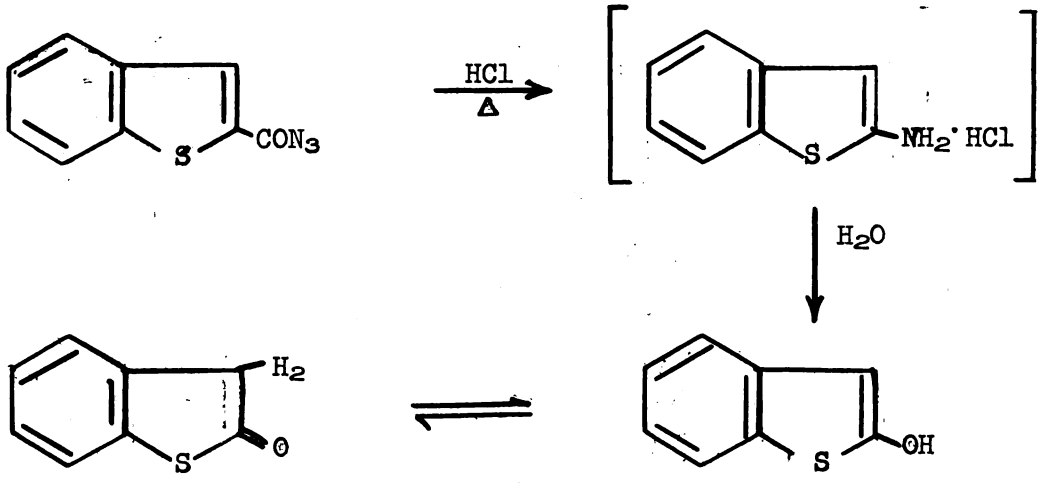
Figure 5. Infrared Spectrum of 2-Thianapthoyl Azide.

of the hydrazide produced the azide. Crystalline thianapthoyl azide is quite stable to light undergoing decomposition to the isocyanate, only after a period of six months exposure. Heating the azide in an inert solvent (toluene), for four hours produced a reddish-orange compound, the isocyanate, which melts at 96°-97° and unrearranged azide which melts at 108°. The attempt to interact sodium azide in absolute ethanol to obtain the azide was unsuccessful.



The infra-red spectra of the heated azide showed strong absorption at 4.39 μ (isocyanate) and 4.68 μ (azide) indicating that the rearrangement was not complete. Heating the azide in acetyl chloride at the reflux temperature of the acid chloride several products were detected through the use of thin strip chromatography; however, the principle product is the one that melts at 96°-97° which is the isocyanate. The infra-red spectra of this crude product mixture showed strong absorption peaks at 4.39 μ and 4.71 μ.

Hydrolysis of 2-thianapthoyl azide with hydrochloric acid gave a product mixture which showed the same infra-red spectra. However, one of the products isolated in very low yield showed none of the characteristic azide and isocyanate absorption peaks in the infra-red. This material showed strong peaks at 2.94 (m) μ (O-H) and 5.83 (s) μ carbonyl. The melting point of this compound was 193°. This data would suggest that this compound might be a mixture of the keto and enol form of 2-hydroxy thianapthene; however, the melting points do not coincide with the literature[5].



Further identification of this material was not carried out, though it has been clearly demonstrated[5] that the amino group in aminothianapthenes can be easily replaced by a hydroxyl group.

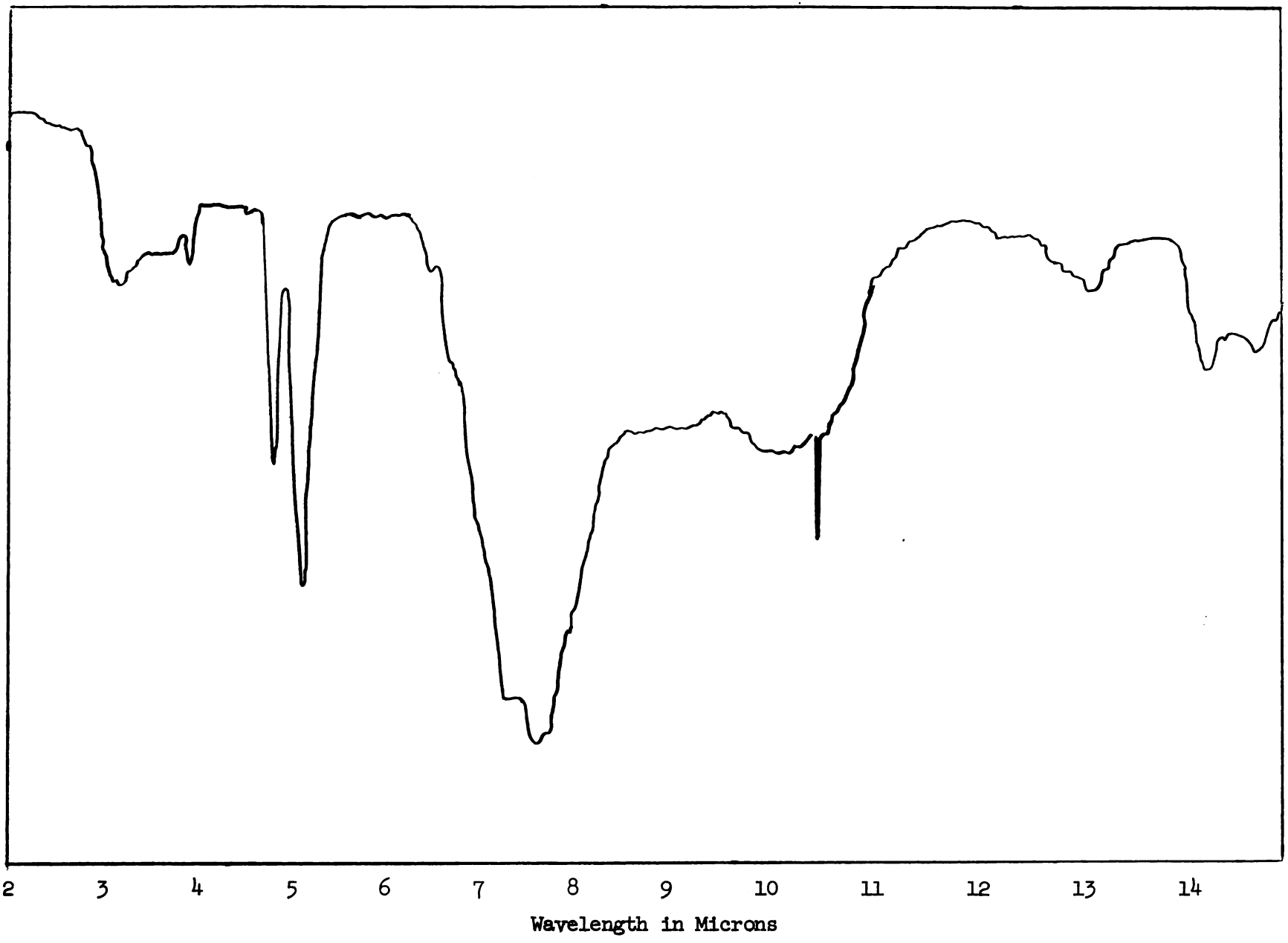


Figure 6. Infrared Spectrum of Hydrolyzed Azide.

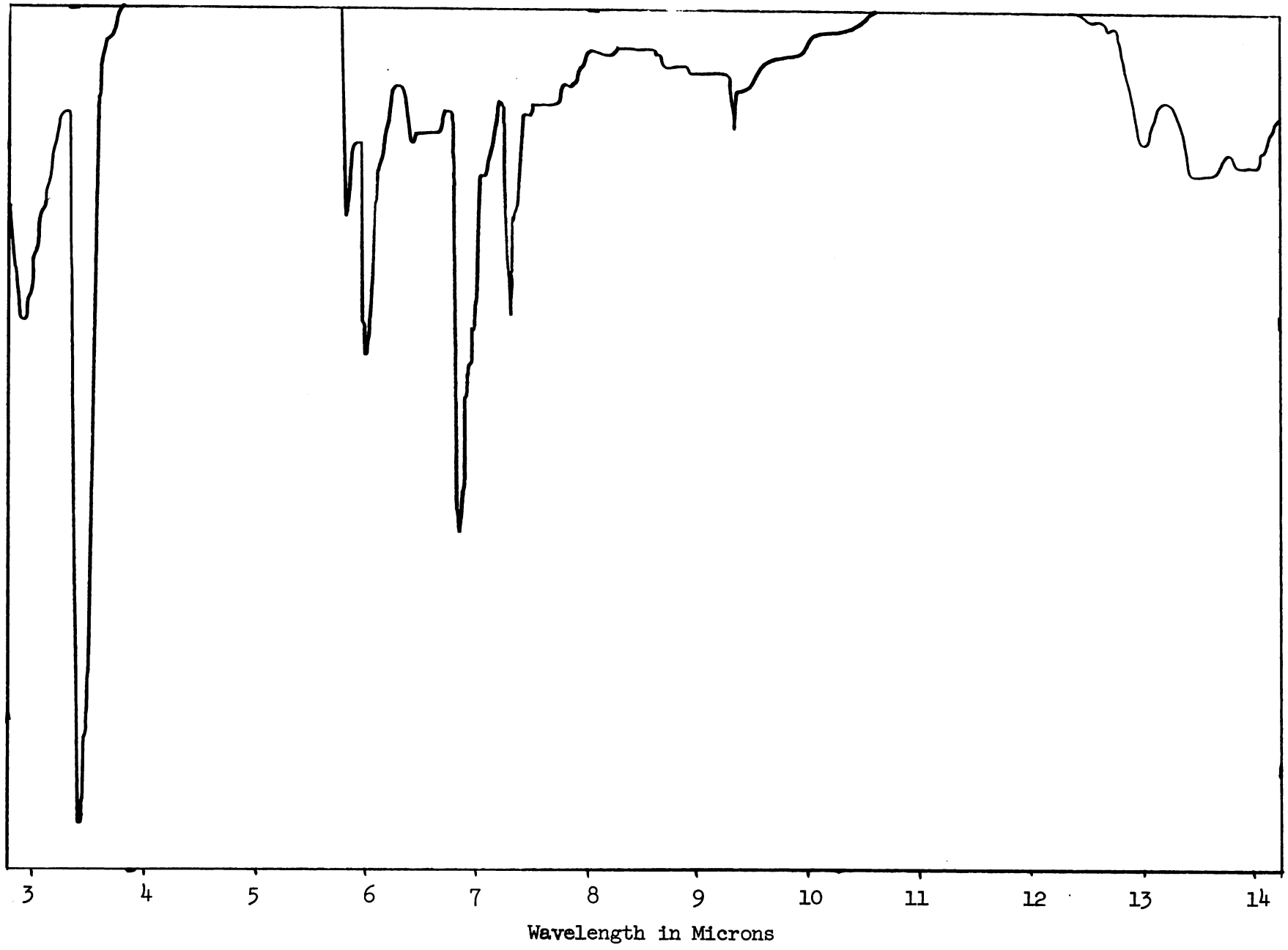
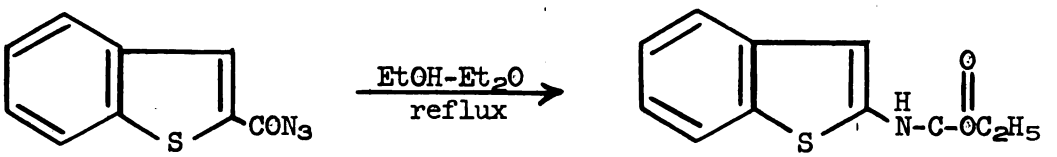


Figure 7. Infrared Spectrum of Heated Azide.

ETHYL N-2-THIANAPTHYL CARBAMATE

The synthesis of ethyl N-2-thianapthyl carbamate was accomplished by heating an ethanol-ether solution of thianapthoyl azide at its reflux temperature.



A crude yellow crystalline mixture was obtained which melted at 148°C. The infra-red spectra showed absorption bands at 3.10 (w)μ, (N-H); 4.76 (w)μ (azide); 5.75 (s)μ, (carbonyl) 6.49 (s)μ, (N-H def.) and 7.86 (m)μ, (N-C). The area of the peak at 4.76 μ was very small indicating that the amount of unrearranged azide was very small. Thin layer chromatography showed that the product mixture contained three major components. However, attempts to separate the compounds on an aluminum oxide column resulted in the isolation of a singular crystalline compound (m.p. 160°-161°C).

The ultra violet spectra of this compound showed λ_{max}^{EtOH} = 229 mμ and (log e = 3.367). The infra-red spectra was identical to that described above except for the absence of the azide absorption peak at 4.70 μ. The n.m.r. spectra strongly supports the structure

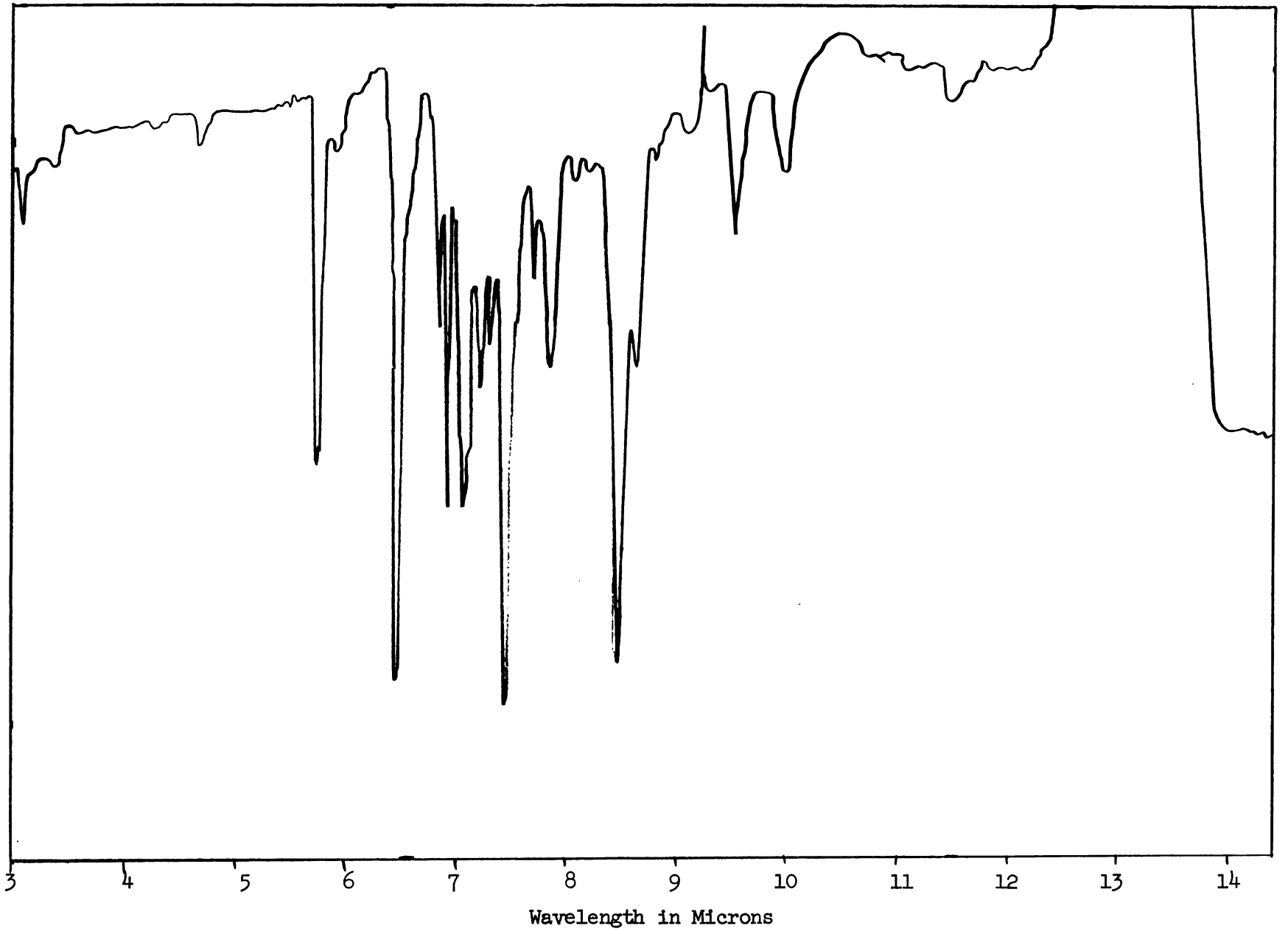


Figure 8. Infrared Spectrum of Ethyl 2-Thianapthyl Carbamate.

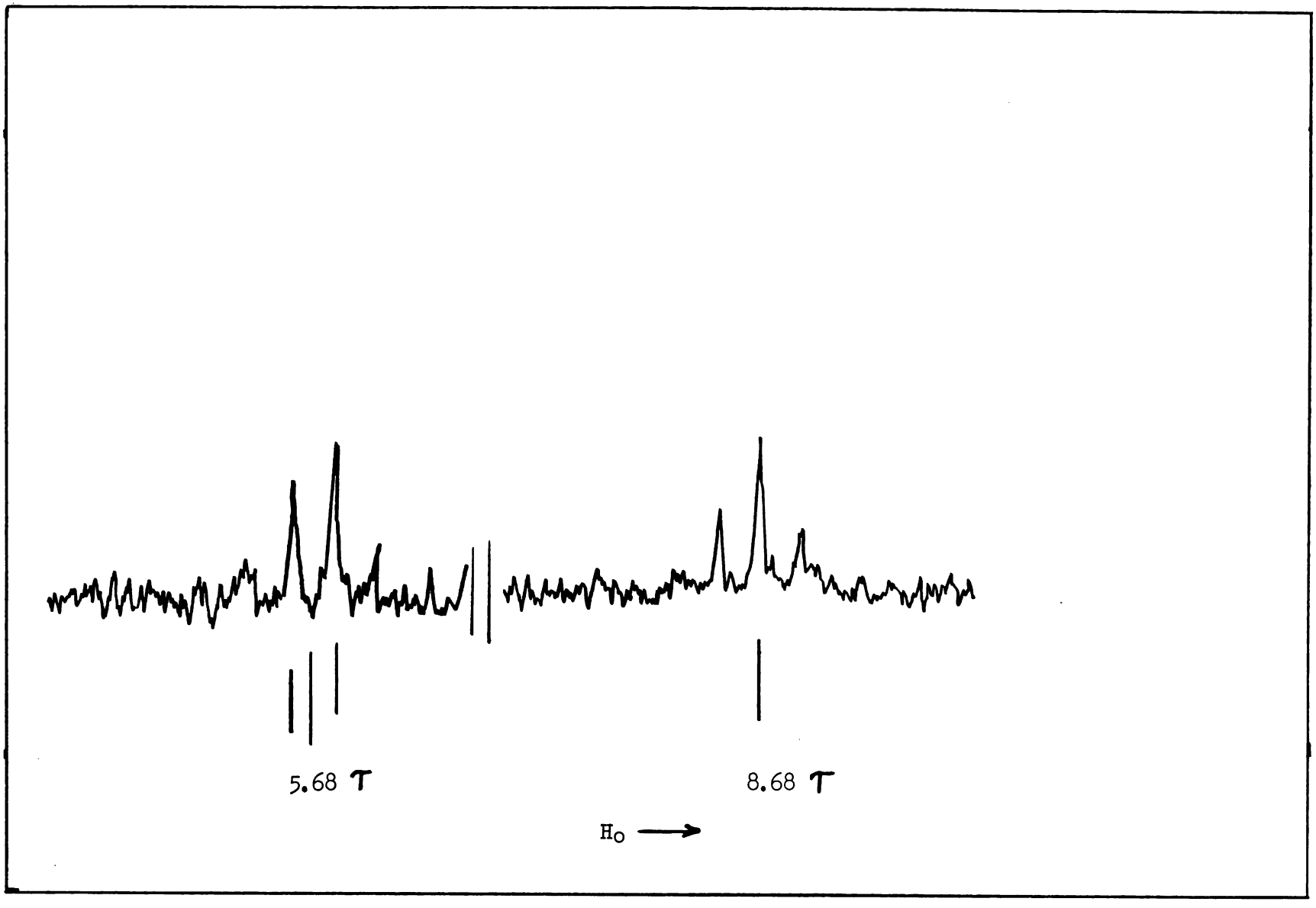


Figure 9. N.m.r. Spectrum of Ethyl 2-Thianapthyl Carbamate in Nitrobenzene Taken At a Sweep Width of 100 c.p.s.

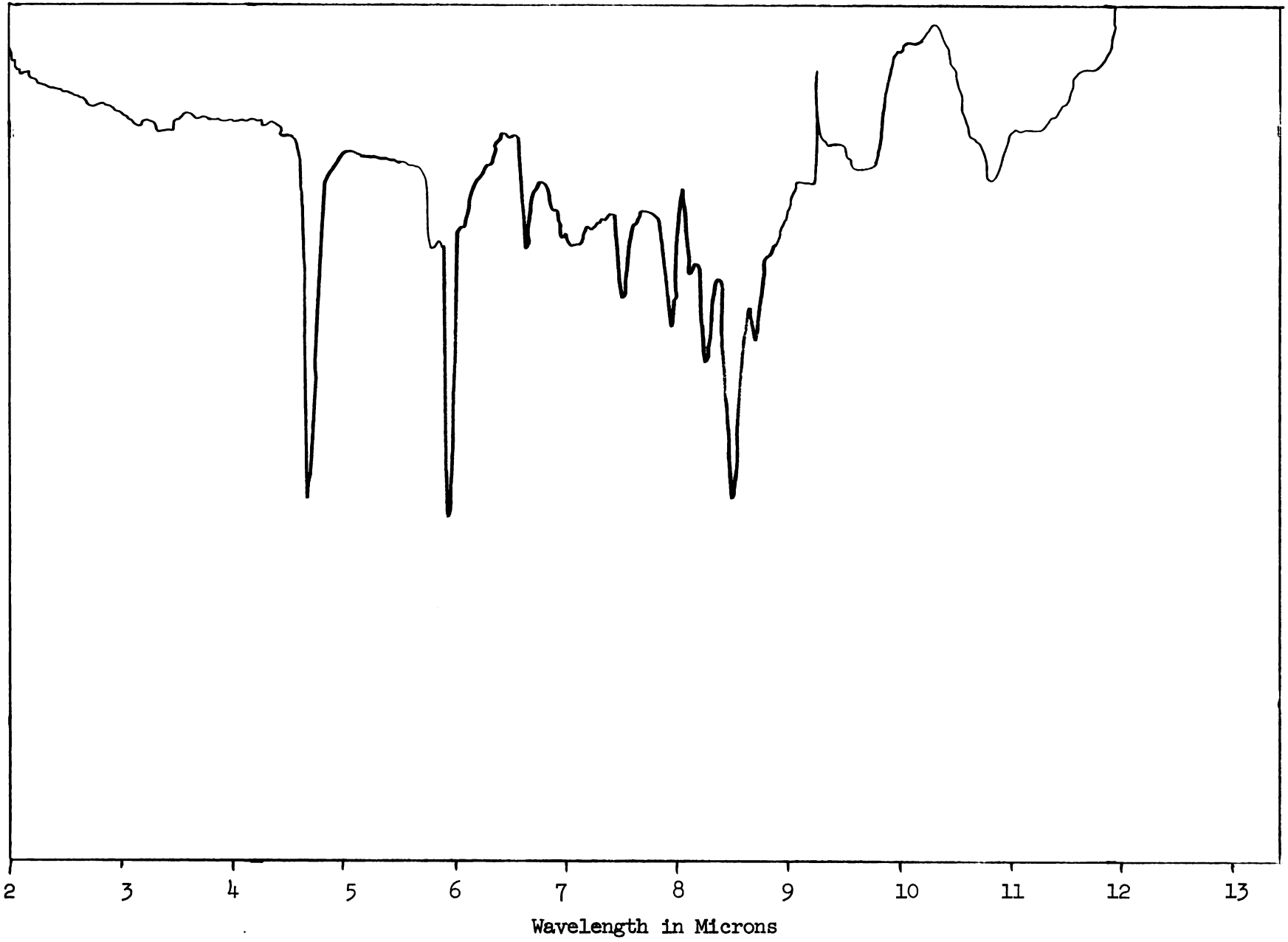


Figure 10. Infrared Spectrum of 2-Thianapthyl Isocyanate.

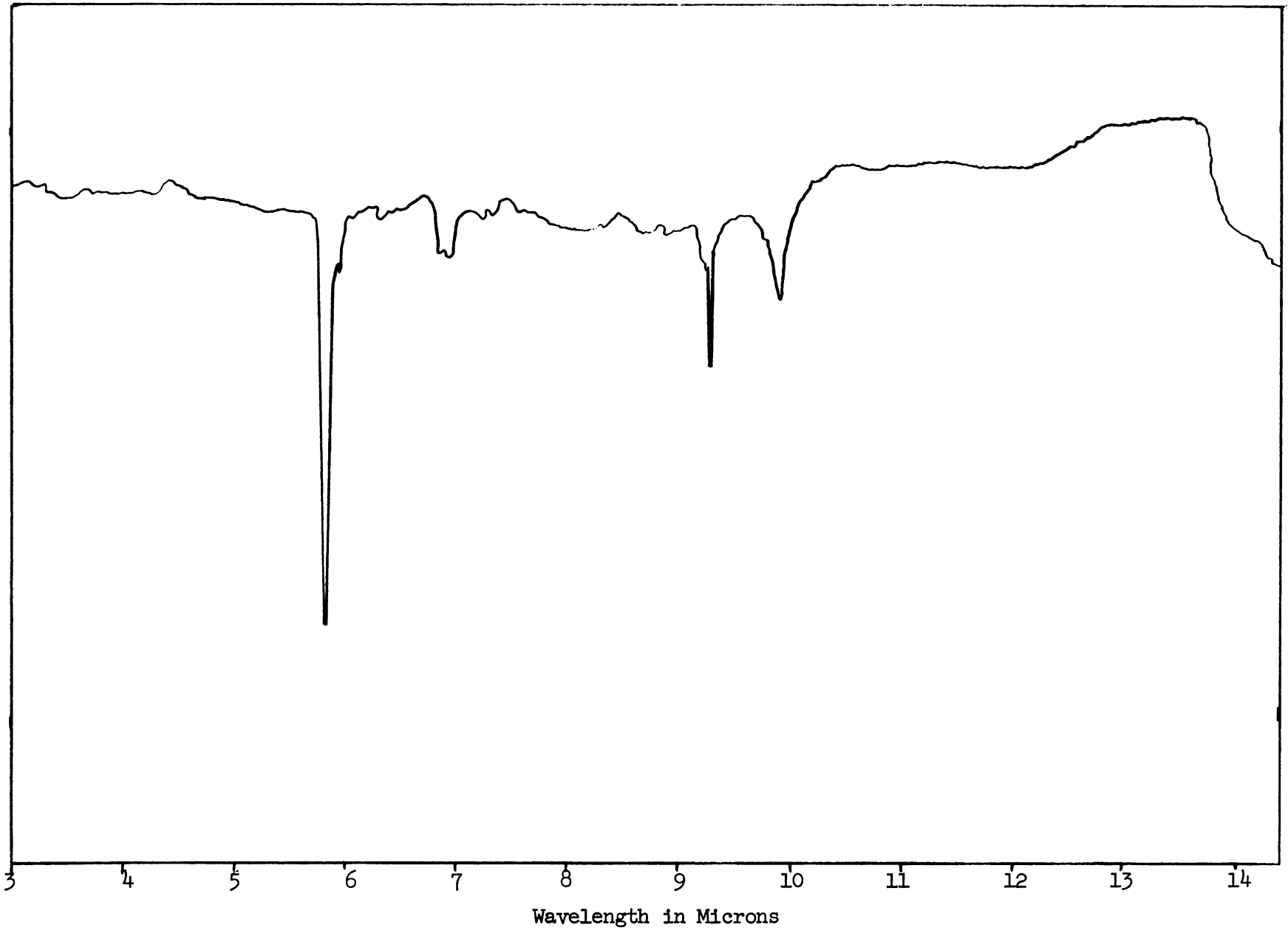
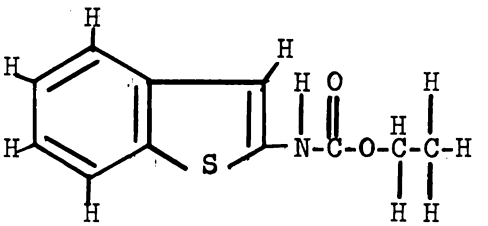
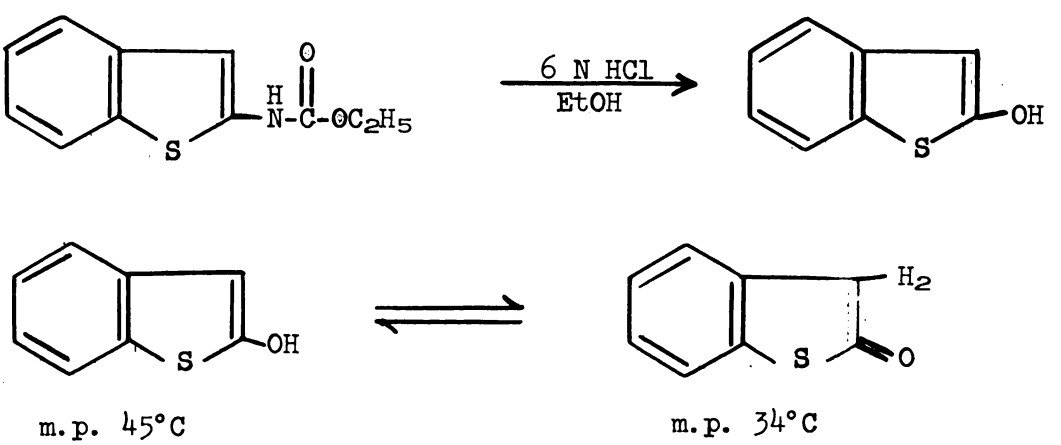


Figure 11. Infrared Spectrum of 2-Keto Thianapthene.

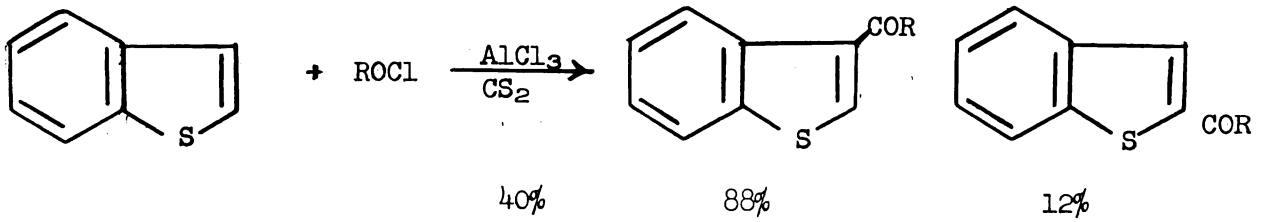


The aromatic rings gave an area ratio of 4:1 for the aromatic protons. In the aliphatic region there is a triplet at 8.73 tau and a quartet at 5.76 tau which shows the presence of the ethyl group. Hydrolysis of the urethane gave a low melting solid (m.p. 34°C) which was the 2-keto thianapthene[5].

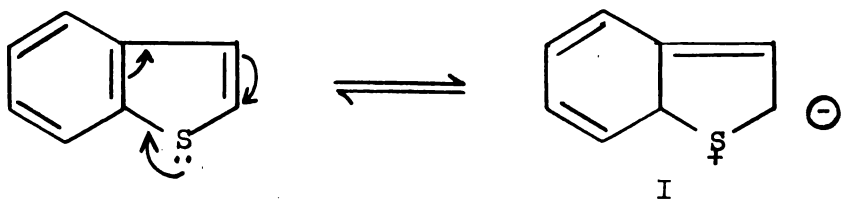


THE BECKMANN REARRANGEMENT

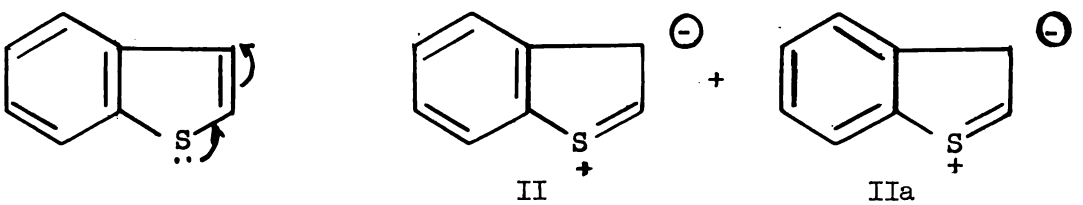
The initial problem involved in a study of this rearrangement with the 2-thianapthyl system was the synthesis of the 2-thianapthyl ketones. Thianapthene can be acylated in the usual manner with acyl halides employing Friedel-Craft type catalyst. Ferrar and Levine[14] have found that thianapthene can be acylated to give a mixture of very low yield of the 2- and 3-isomers; however, the 3-isomer is the predominant product.



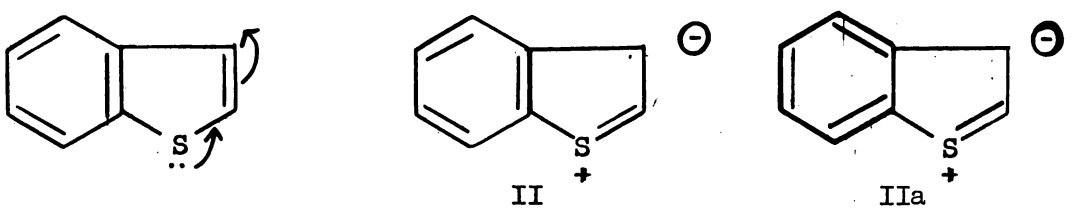
The above results can be best explained by the resonance structures I and II[1]. The formation of I requires resonance interaction involving the benzene ring which is not necessary



I

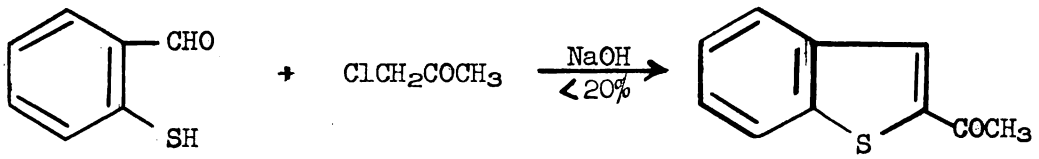


II IIa

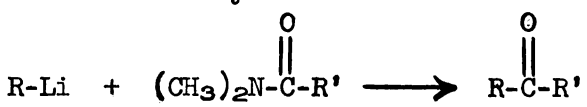


II IIa

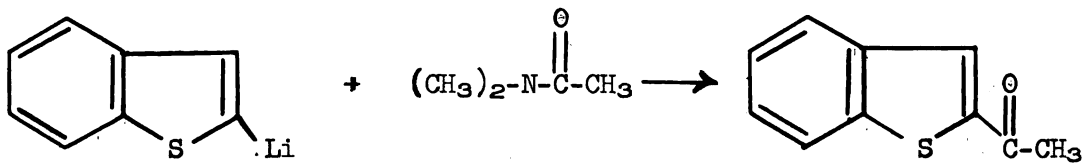
for the formation of II. Further there are two ionic structures II and IIa in which the negative charge is in the two position while there is only one such structure in I. Another classical method used for the preparation of 2-thianapthyl ketones involves a ring closure procedure. The ring closure of o-mercaptobenzaldehyde with chloroacetone gives a very low yield of 2-acetyl thianapthene[6]. Since methods described in



the literature to obtain the necessary intermediate 2-thianapthyl ketones gave very poor yields of the desired products, an alternate was sought. The method of interacting an alkyl lithium with a dimethylamide was used[15].



Interacting 2-thianapthyl lithium with N,N-dimethylacetamide gave a yield of 56% of 2-acetyl thianapthene. This compound was readily converted to its oxime.



56%

As one might suggest, the anti 2-thianapthyl methyl ketoxime was obtained. Since the thianapthyl group is bulky and much larger than the methyl group, the most stable confirmation is that having the thianapthyl group anti to the hydroxyl group.

The oxime was treated with phosphorus pentachloride to cause it to undergo the Beckmann rearrangement. However, this reagent was much too strong and a polymer-like material was obtained. Similar results were obtained with the use of 96% sulfuric acid. The best catalyst for this was the use of 85% phosphoric acid. Under these mild conditions, and at

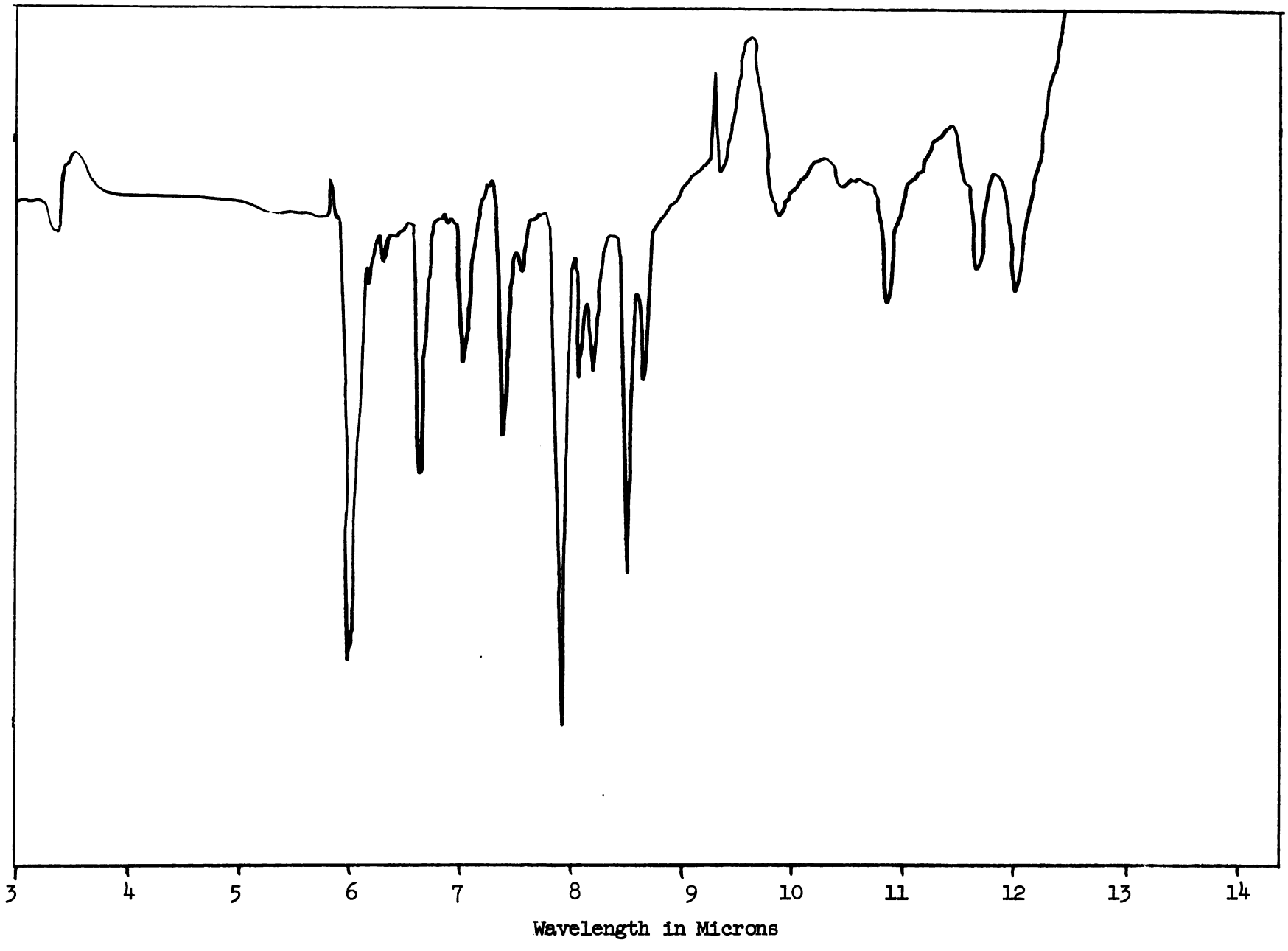
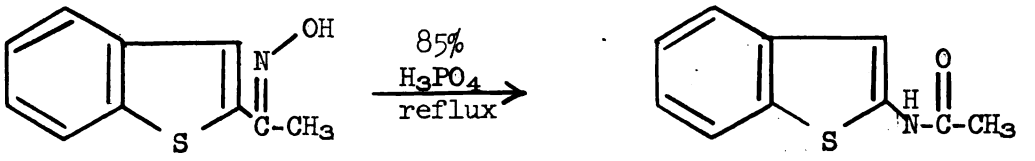


Figure 12. Infrared Spectrum of 2-Acetyl Thianapthene.

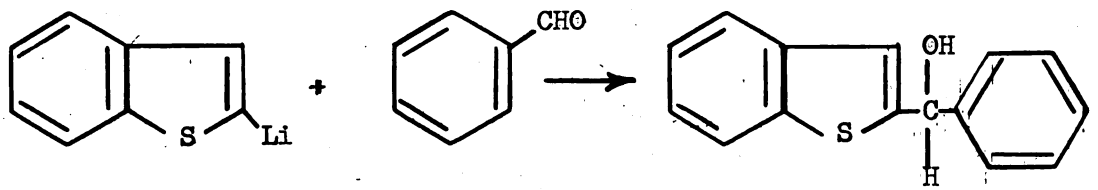


reflux temperature for only one hour was sufficient to obtain rearrangement of the oxime. The compound obtained after purification melted at 84°-85°C. The infra-red spectra showed amide absorption band I at 5.98 (s)μ, (carbonyl); band II at 6.58 (s)μ, (N-H def.); and band III at 8.05 (s)μ, (N-C). The n.m.r. spectra showed an area ratio of aromatic protons of 4:1 and a singlet at 7.92 tau due to the unsplit methyl group. Methyl groups next to carbonyls vary from 7.80 tau to 8.05 tau[17]. Acetamide shows a singlet at 7.98 tau[16], indicating that the singlet at 7.92 tau is the methyl group next to the carbonyl. The structure of the oxime was concluded from the structure of the rearranged product.

PHENYL 2-THIANAPTHYL KETONE

Phenyl 2-thianapthyl ketone was prepared by the oxidation of the corresponding alcohol.

Phenyl 2-thianapthyl carbinol was prepared as described by Shirley and Cameron[17], using the interaction of 2-thia-



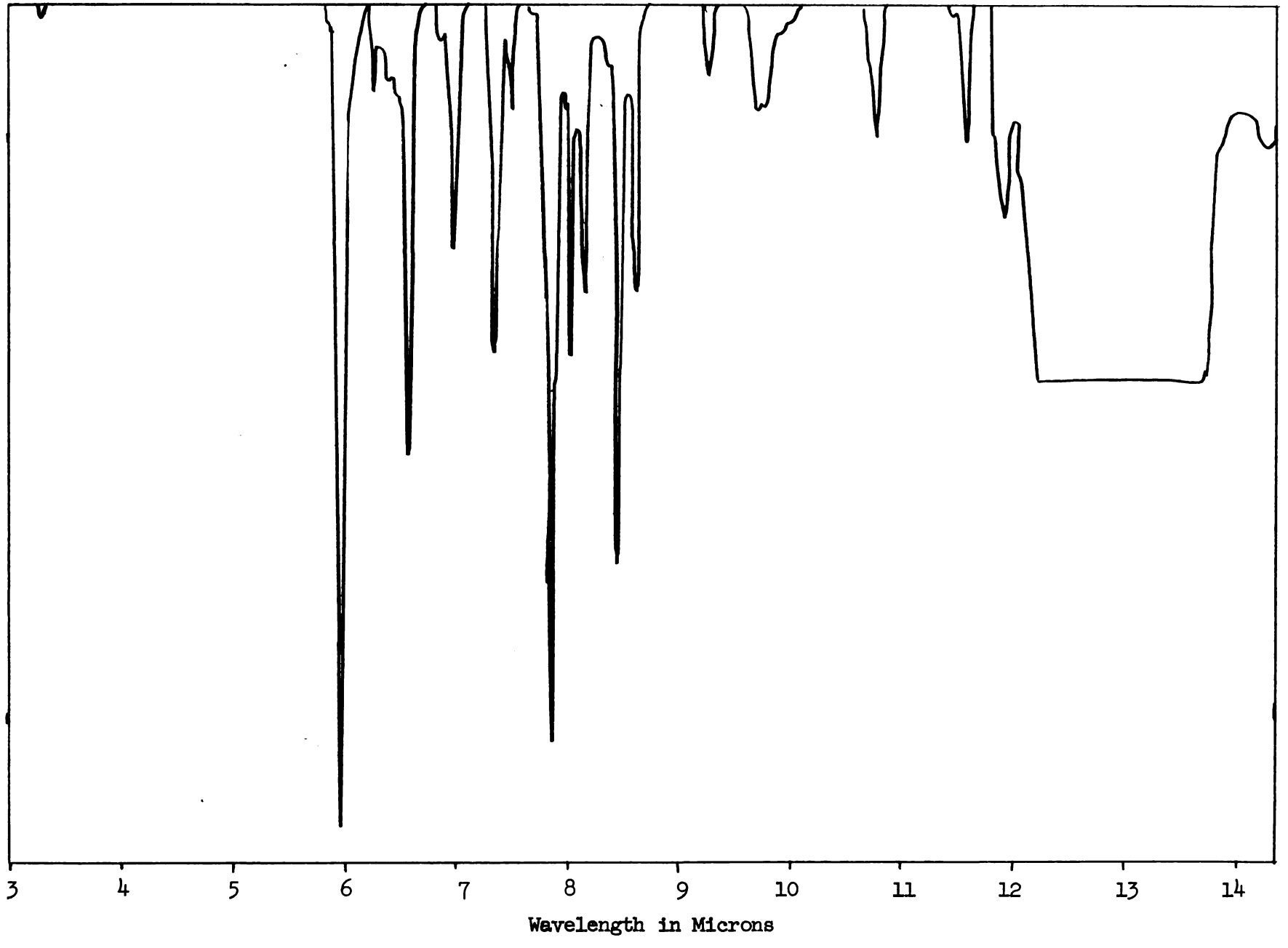


Figure 13. Infrared Spectrum of N-Acetyl 2-Thianapthylamine.

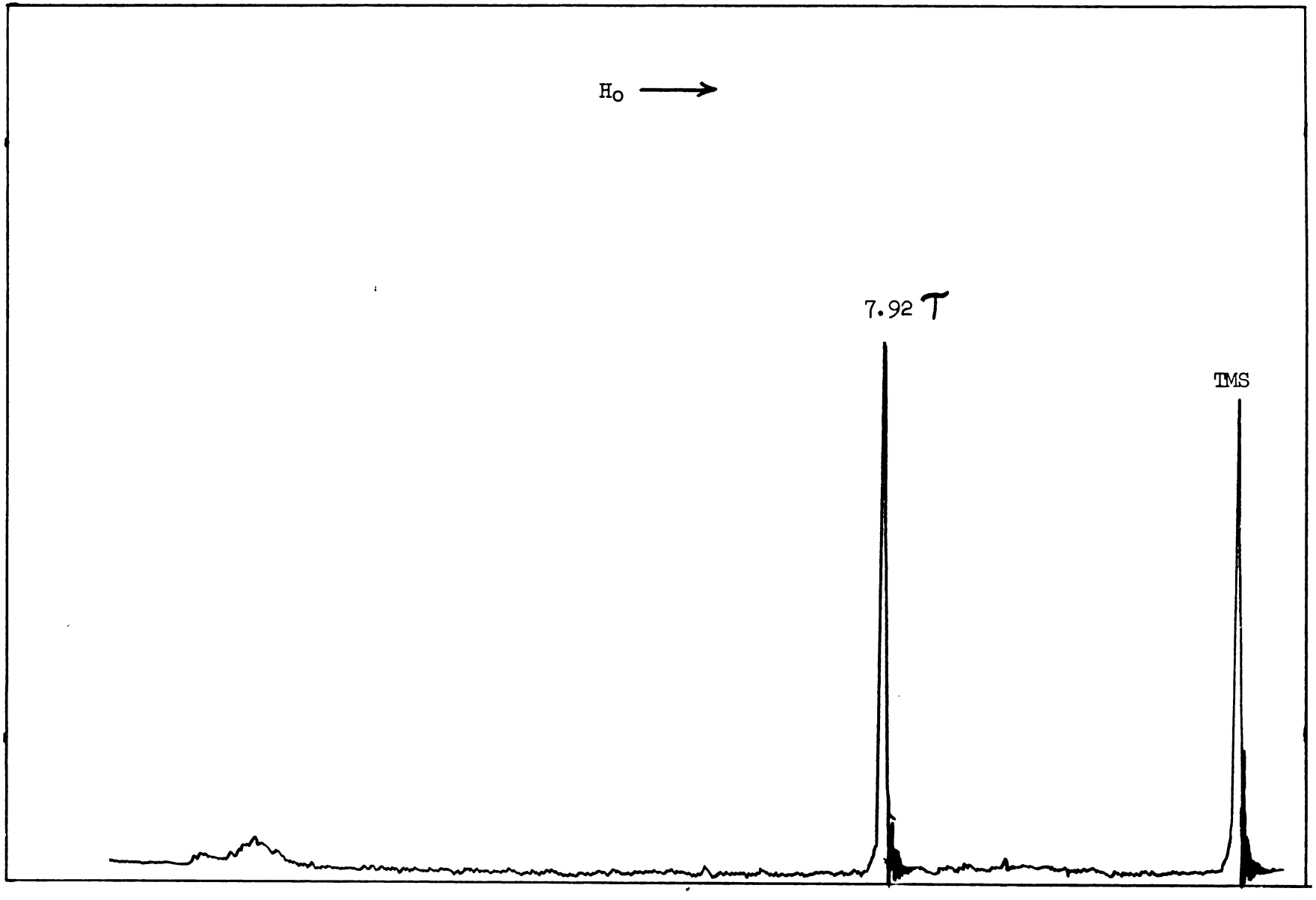
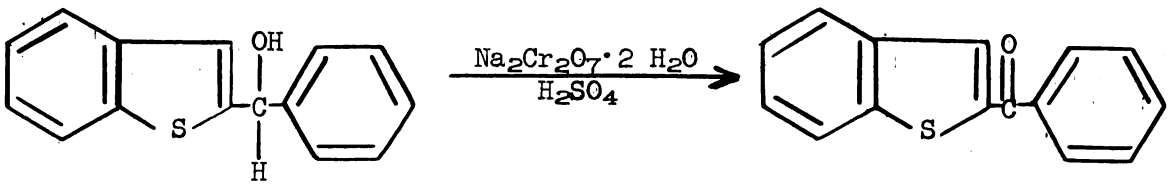
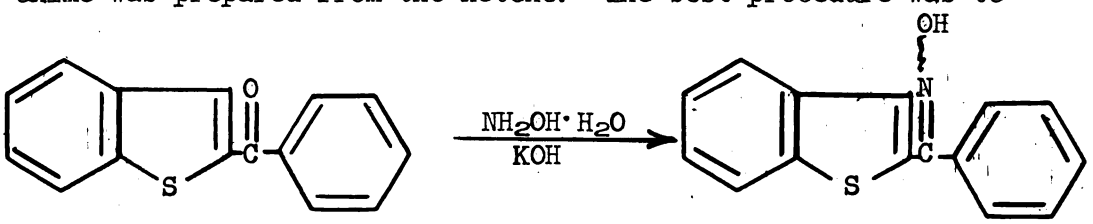


Figure 14. N.m.r. Spectrum of N-Acetyl 2-Thianapthylamine in Benzene Taken At A Sweep Width of 500 c.p.s.

napthyl lithium and benzaldehyde. The oxidation of the alcohol initially presented some difficulties. An Oppenauer oxidation of this alcohol gave less than a 5% yield of the ketone. Dichromate oxidation, using the procedure of Brown[18], was attempted. That is, by slowly adding sodium dichromate and sulfuric acid to a well stirred solution of the alcohol.



This procedure produced a 69% yield of the crude low melting solid. Since the ketone was a low melting solid (m.p. 47°-48°C), it was necessary to use a low boiling solvent for recrystallization in order to keep it from coming out of solution as an oil and carrying the impurities out of solution with it. (Previous attempts to vacuum distill the ketone led to a tar-like product and no distillate.) Petroleum ether was used as the solvent for recrystallization. Shapely monoclinic crystals were obtained. The infra-red spectra showed the characteristic aromatic protons 3.30 (m)μ, carbonyl 6.10 (vs)μ and phenyl 6.25 (m)μ, 6.63 (s)μ, 6.90 (m)μ. The oxime was prepared from the ketone. The best procedure was to



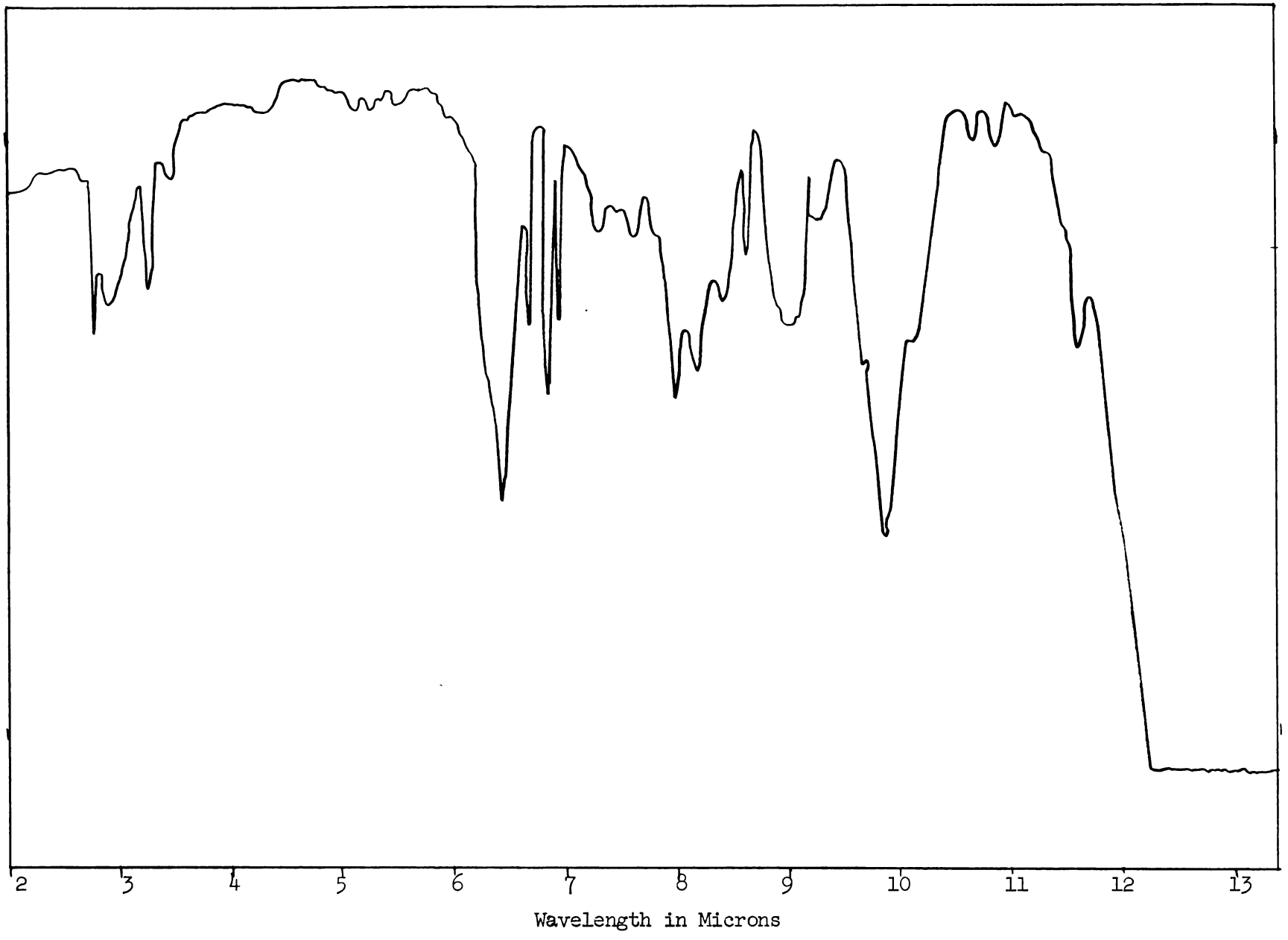


Figure 15. Infrared Spectrum of Phenyl 2-Thianapthyl Carbinol.

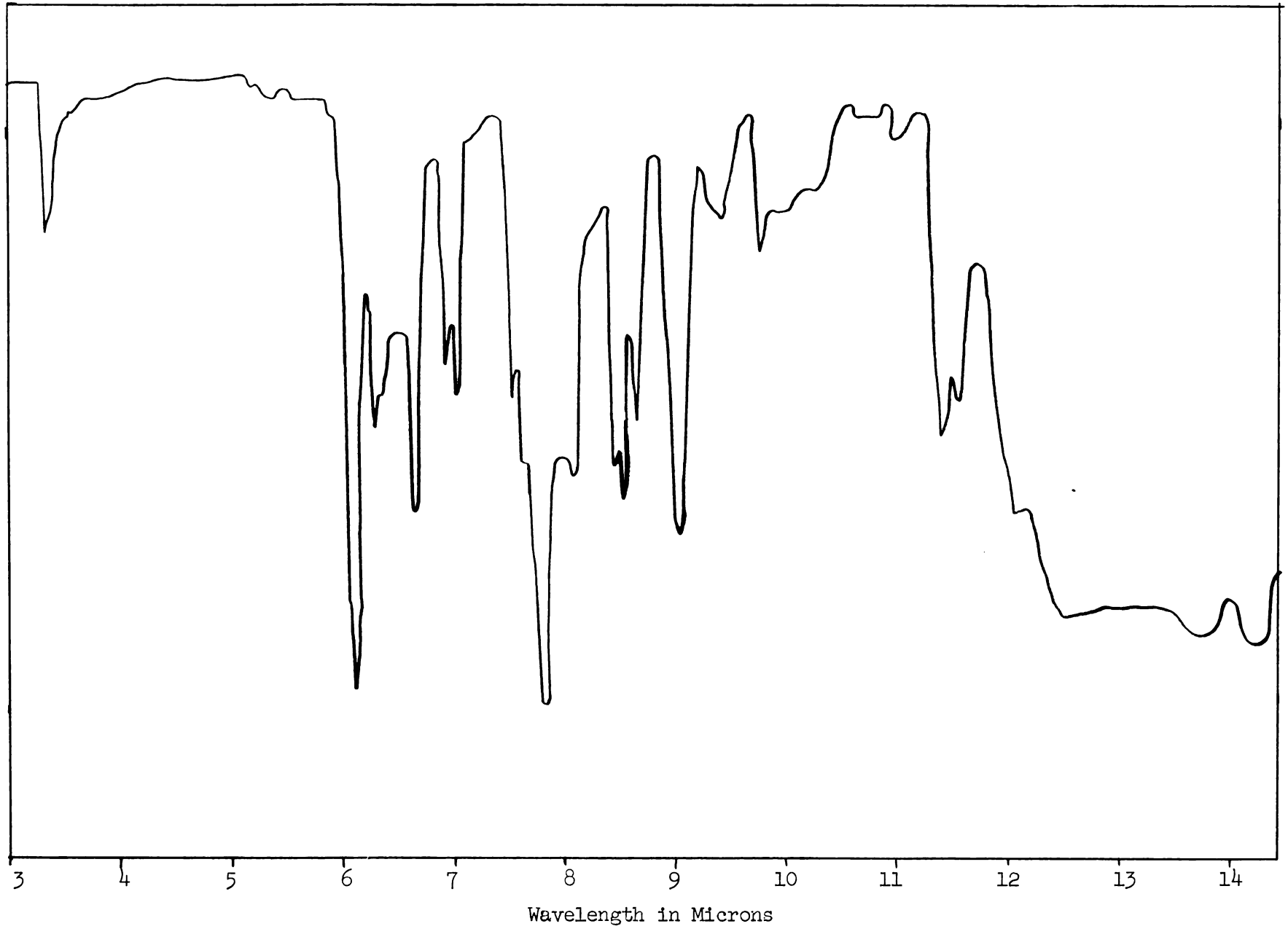


Figure 16. Infrared Spectrum of Phenyl 2-Thianapthyl Ketone.

dissolve the ketone in 95% ethanol and add potassium hydroxide along with the necessary amount of hydroxylamine hydrochloride. A brownish solid was obtained. Recrystallization from a water-acetone mixture produced a white crystaline compound, m.p. 145°-147°C.

EXPERIMENTAL

All infra-red spectra were obtained on a Perkin-Elmer Model 21 recording infra-red spectrophotometer, using a sodium chloride cell. The bands were determined in microns. The ultraviolet spectra were determined in 1-cm ground stoppered quartz cells using a Beckmann DK-2 spectrophotometer.

Proton magnetic resonance spectra were obtained on a Varian Model A-60 instrument. All spectra were obtained at 60 Megacycles using tetramethylsilane as an internal standard. The band positions were recorded in τ (tau) units as prescribed by Tiers[20].

THIN STRIP CHROMATOGRAPHY

An 18.0 g. (0.017 moles) quantity of aluminum oxide and 12 g of plaster of paris were mixed in a petre dish with 32 ml. of 2% sodium hydroxide solution. Using a spatula, two levels of the mixture were placed and spread on a microscope slide. The strips were dried in air for 3 hours and then they were placed in an oven to dry at 100°C. for 4 hours. The strips were removed from the oven and stored in a dessicator containing potassium hydroxide. 20 Strips.

The chromatographic strips were used on reaction mixtures or impure solids. The impure compound was dissolved in acetone using a small melting point capillary. Approximately six drops were placed in a spot at the bottom of the strip. The strip was then dried with air and placed into a test tube containing enough eluent to touch the bottom part of the strip. After the solvent traveled the length of the strip it was removed and dried with air. Isatin-sulfuric acid was used as the dye to develop the spots on the strip. The eluent was varied until there was a clear distinction of products. This procedure can be used as a pre-check to find the proper eluting solvent on a chromatographic column or to determine the number of components in a reaction mixture.

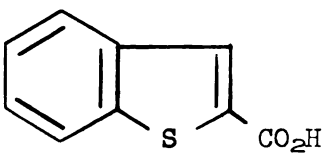
LITHIUM SAND

To obtain a more reactive lithium for metalation reactions, it is necessary to use lithium sand; that is, a state of division of the metal giving a very large surface area.

Approximately 10.2 g. (1.60 moles) of lithium wire, cut into 5 x 1 cm. strips, were placed in an iodine flask, containing 100 ml. of mineral oil. The suspension of metal and mineral oil were heated, with a bunsen burner, until the temperature was approximately 200°C. Using asbestos gloves, the flask was firmly stoppered and shaken vigorously for 5-

10 minutes and then was set aside to cool to room temperature. The finely divided lithium sand was recovered by decantanation, washed with ether to remove the mineral oil and stored under ether until used.

2-THIANAPTHOIC ACID

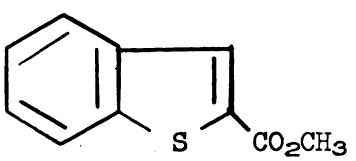


Thianapthene was metalated as described by Shirley and Cameron[12].

A liter three neck round bottom flask fitted with a stirrer, dropping funnel, nitrogen inlet tube and condenser with an attached calcium chloride drying tube was charged with 200 ml. of anhydrous ether and 7.1 g. (1.02 moles) of lithium sand. The reaction flask was cooled below -10° by immersion in a dry ice 2-propanol bath and a solution containing 141.0 g. (1.07 moles) of n-butyl bromide dissolved in 100 ml. of anhydrous ether was slowly added during two hours. The reaction mixture was stirred for an hour following the addition of the n-butyl bromide and then 81.0 g. (0.60 moles) of thianapthene dissolved in 150 ml. of anhydrous ether was added to the cooled alkyl-lithium solution during a half hour. To obtain a maximum quantity of thianapthyl lithium, the ether solution was subjected to a mild vacuum

with a water aspirator, forcing the equilibrium in the direction favoring the production of the organometallic. The reaction mixture became viscous and required the addition of ether several times to permit good stirring. The thianapthyl lithium solution was poured over a slurry of carbon dioxide and ether. Following the evaporation of the carbon dioxide, the resulting solution was acidified with a 5% hydrochloric acid solution to obtain the crude acid. The crude product was recrystallized from methanol to obtain 138.0 g. (0.77 moles) of pure acid which had a melting point of 234°-236°C. (lit.[12] 234°-236°C).

METHYL 2-THIANAPTHOATE

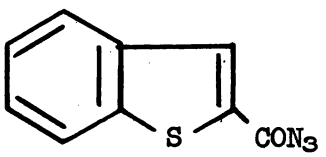


2-Thianapthoic acid was esterified with diazomethane. The diazomethane was prepared as described by Vogel[19].

To a four liter beaker containing 54.0 g. (0.91 moles) of acetamide, 88.0 g. (0.55 moles) of bromine was added very slowly. The alkaline solution was heated until effervesence occurred. The white crystalline acetyl methyl urea was recovered by filtration and washed with 100 ml. of cold water. It was dissolved in 50 ml. of concentrated hydrochloric acid and heated for 8-10 minutes. The solution was cooled to 0°C and 38.0 g. (0.447 moles) of sodium nitrite was carefully added to the acid solution. The nitroso-methyl urea (m.p. 123°-124°C.) was recovered by filtration and stored for use.

A 60 ml. volume of 50% potassium hydroxide diluted with 200 ml. of ether was added to a 500 ml. round bottom flask fitted with a side arm condenser. The flask was cooled to 0°C and 20.0 g. (0.194 moles) of nitroso-methyl urea was slowly added with occasional shaking. The reaction flask was warmed on a steam bath and the evolved diazomethane was bubbled directly into 100 ml. of ether contained in a conical flask. The diazomethane ether solution was then cautiously added to a solution of 2-thianapthoic acid in ether. Excess diazomethane was tested for by adding a drop of glacial acetic acid and nitrogen evolution was observed. The m.p. of the ester was 72°-73°C. Literature value: 72°-73°C.[5,12].

2-THIANAPTHOYL AZIDE



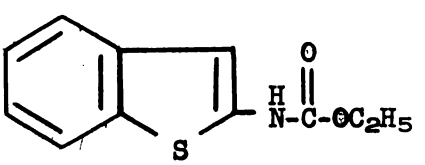
A 100 ml. round bottom flask was charged with 13.0 g. (0.067 moles) of methyl thianapthoate dissolved in 25 ml. of 95% ethanol. An excess of hydrazine hydrate [10.0 g. (0.25 mole)] was added to the alcoholic solution and the reaction mixture was heated on a steam bath for five hours to obtain 21.0 g. (0.104 moles) of 2-thianapthoyl hydrazide (m.p. 184°-185°C.)[4]. The hydrazide was dissolved in 100 ml. of ethanol and added to 90 ml. of acetic acid saturated with sodium

nitrite. The long needle-like crystals of product, which separated, were collected on a filter and recrystallized from an ethanol-water mixture. A 50% yield of 10.0 g. (0.049 moles) of 2-thianapthoyl azide was obtained which melted at 108° with decomposition.

The azide, when heated in a test tube, produces an oily redissh-brown residue which on recrystallization from ethanol yields a fine powdered solid (m.p. 96°C.).

Treatment of the azide with acetyl chloride yielded a solid isocyanate (m.p. 96°-97°C.). Simple heating of the azide in a toluene solution for four hours also produced the isocyanate. Infra-red analysis of these materials gave the characteristic isocyanate absorption peaks.

ETHYL N-2-THIANAPTHYL CARBAMATE



Into a three necked round bottom flask equipped with a stirrer, 1.77 g. (0.008 moles) of 2-thianapthoyl hydrazide dissolved in 100 ml. of water and 20 ml. of 6 N hydrochloric acid were added. The reaction flask was cooled to below 5°C by immersion in an ice bath. A 100 ml. volume of ether was added, followed by a solution containing 4.0 g. (0.058 moles)

of sodium nitrite dissolved in 50 ml. of water. The azide produced was extracted into the ether layer. The two layers were separated and the aqueous layer was washed with three 50 ml. portions of ether. The combined ether layers were dried, first over anhydrous sodium carbonate for five minutes and then over calcium chloride for ten minutes. The dried ethered solution of 2-thianapthoyl azide was decanted into a 300 ml. three-necked round bottom flask equipped with a stirrer and condenser. A 40 ml. volume of absolute ethanol was added to the reaction flask and the ether was removed by distillation on a steam bath. When the ether had been removed the azide-alcohol reaction solution was heated at its reflux temperature. The solution was concentrated by distillation to about 25 ml. to obtain the urethane. This was recovered by filtration and recrystallized from ethanol to obtain a pure product in the form of yellow colored crystalline needles. This material melted at 148°-160°C. (Lit. 160°-161°C.)[4] indicating it was impure.

The yellow crystalline solid was dissolved in a minimum volume of acetone and applied as a spot on a chromatographic strip. On elution with a 50:50 mixture of petroleum ether and ethyl acetate, three spots were observed when the isatin sulfuric acid test was applied. These spots were probably the azide, the isocyanate and the urethane. The remainder of the acetone solution was then applied to a chromatographic

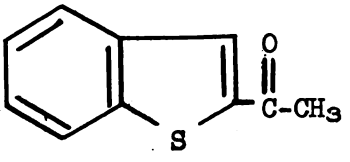
column prepared from cotton, sand and alumina. The column was eluted with a 50:50 mixture of petroleum ether and ethyl acetate. Six fractions of 10 ml. each were collected. On evaporation, fraction V yielded a white solid (m.p. 160°-161°C.), λ_{max}^{EtOH} 229 mμ (log e = 3.367).

Anal.

Calc'd.: $C_{11}H_{11}NO_2S$: C, 59.73; H, 4.97; N, 6.33; S, 14.48.

Found : C, 59.41; H, 5.41; N, 6.30; S, 13.87.

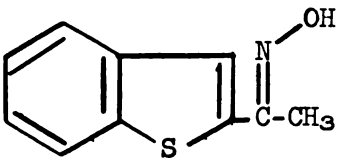
2-ACETYL THIANAPTHENE



Thianapthene was metalated using 13.8 g. (2.0 moles) of lithium, 136 g. (2.0 moles) of n-butyl bromide on 116.0 g. (0.870 moles) of thianapthene as described previously.

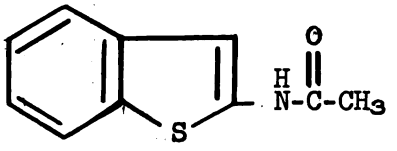
An 87.0 (1.0 mole) quantity of N,N-dimethyl acetamide was added slowly to the cold (-10°C) stirred solution of 2-thianapthyl lithium. The reaction mixture was stirred for an additional hour and then extracted with water. The ether was removed by evaporation and 85.0 g. (0.20 moles) of a yellow crystalline solid was obtained. This was purified by sublimation to yield 76.0 g. (0.442 moles, 56%) of a pure product which melted at 87°-88°C. Literature[6]: 87°-88°C.

syn-METHYL 2-THIANAPTHYL KETOXIME



A solution containing 25.0 g. (0.144 moles) of 2 acetyl-thianapthene, 15.0 g. (0.218 moles) of hydroxylamine hydrochloride, 28.0 g. (0.70 mole) of sodium hydroxide dissolved in 50 ml. of 95% ethanol was heated at its reflux temperature for five minutes. The basic solution was cooled and poured into 75 ml. of cold 6 N hydrochloric acid solution. The solid material which separated was collected on a filter. Sublimation of the crude material produced two products. One compound (less then 0.2 g.) melted at 33°-34°C and the main product (13.0 g.) melted at 181°-182°. Literature value: 183°C.[6].

N-ACETYL 2-THIANAPTHYLAMINE

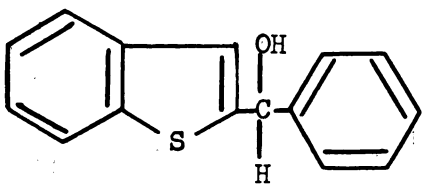


A 2.0 g. (0.016 mole) quantity of a 2-thianapthyl ketoxime was dissolved in 25 ml. of 85% phosphoric acid and

the acid solution was heated at its reflux temperature for an hour. An oily brown liquid which solidified on cooling was obtained and purified by sublimation (m.p. 84°-85°C.).

The infra-red spectrum of this material showed strong absorption peaks at 2.99 (w)μ, 3.26 (w)μ, 5.95 (s)μ, 6.61 (s) μ, 7.87 (s)μ, 8.16 (m)μ, and 13.78 (s)μ. The n.m.r. spectra showed a singlet at 7.92 tau.

PHENYL 2-THIANAPTHYL CARBINOL

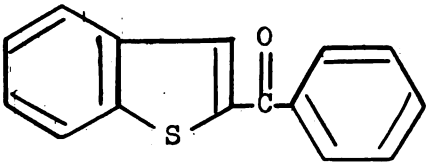


Phenyl 2-thianapthyl carbinol was prepared as described by Shirley and Cameron[17] with some modification of their experimental procedure. A two liter three-neck flask was fitted with a stirrer, dropping funnel, nitrogen inlet tube and condenser with an attached calcium drying tube was charged with 200 ml. of anhydrous ether and 25.0 g. (3.6 moles) of lithium sand. The reaction flask was cooled below -10°C by immersion in a dry-ice 2-proponal bath and a solution of 260.0 g. (1.9 moles) of technical grade n-butyl bromide dissolved in 200 ml. of anhydrous ether was added slowly during a two hour period. Following addition of the alkyl-halide solution, 179.0 g. (1.36 moles) of thianapthene dissolved in 100 ml. of anhydrous ether was added to the cooled alkyl lithium solution.

The thianapthyl lithium solution was subjected to a mild vacuum with a water aspirator, forcing the equilibrium in the direction favoring production of the organo metallic. The reaction mixture became rather viscous and required the addition of ether several times to permit effective stirring. A solution containing 134.0 g. (1.4 moles) of benzaldehyde dissolved in 200 ml. of anhydrous ether was added during a 45 minute period to the cooled (-10°C) thianapthyl lithium solution. The reaction mixture was stirred for an additional hour at a temperature between 0°-15°C., following the addition of the benzaldehyde. The reaction mixture was then heated at its reflux temperature for a half hour and poured over a solution of ammonium chloride containing crushed ice. The water layer was extracted with ether and the combined ether layers were evaporated to dryness to obtain 236.0 g. (0.98 moles, 82%) of crude alcohol, m.p. 83°-85°. Literature: 84°-85°C.

The yellow crystallizing material was recrystallized from warm ligroin to obtain a 210.0 g. (0.92 moles, 78%) quality of pure product, melting in the temperature range of 84°-85°C.

PHENYL 2-THIANAPTHENYL KETONE



A 17.61 g. (0.075 mole) quantity of phenyl 2-thianapthyl carbinol dissolved in ether was added dropwise to a stirred solution containing 15.1 g. (0.051 mole) of sodium dichromate dihydrate, 6.78 ml. of concentrated sulfur acid and 50 ml. of water. The stirred solution was heated at its reflux temperature for four hours. The ether layer was separated and washed successivley with a 10% sodium hydroxide solution, saturated sodium bicarbonate and finally with water. The washed ether layer was dried over calcium chloride and then evaporated to dryness. An oily residue which solidified after setting overnight was obtained. A 69% 12.2 g. (.051 moles) yield of crude product, melting in the temperature range of 45°-51°C., was obtained. The crude material was recrystallized from petroleum ether (b.p. 30°-60°) m.p. 48°-49°C.

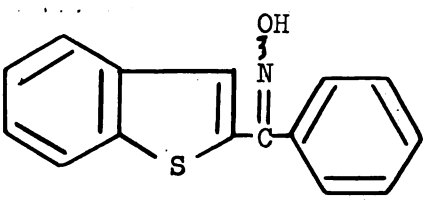
Anal.

Calc'd.: $C_{15}H_{10}OS$: C, 75.60; H, 4.19; S, 13.45.

Found : C, 75.81; H, 4.44; S, 13.37.

λ_{max}^{EtOH} = 306.5 mμ (log e = 4.218).

PHENYL 2-THIANAPTHYL KETOXIME



A 3 g. (0.022 moles) quantity of phenyl thianapthyl ketone was dissolved in 70 ml. of 95% ethanol and 3 g. (0.044 moles) of hydroxylamine hydrochloride along with 12 g. (0.214 moles) of potassium hydroxide were added to a 300 ml. one-necked round bottom flask equipped with a condenser. The reaction mixture was refluxed for 2 hours and poured into 200 ml. of water. The suspension was stirred and then acidified with a 6 N hydrochloric acid solution. The yellow solid which separated was collected on a filter. The crude mixture was then dissolved in warm acetone and water was added dropwise until the solution became turbid. After settling for a few minutes a brown oil separated. The top layer was decanted and allowed to set overnight. White needle-like crystals were obtained (m.p. 145°-147°C.).

Anal.

Calc'd.: $C_{15}H_{11}NOS$: C, 71.15; H, 4.35; N, 5.53; S, 12.65.

Found : C, 71.17; H, 4.48; N, 5.46; S, 12.67.

SUMMARY

1. 2-Thianapthyl isocyanate was prepared and characterized. This compound was previously unreported.
2. Ethyl N-2-thianapthyl carbamate was prepared and characterized by n.m.r. spectroscopy.
3. 2-Acetyl thianapthene was prepared by a new procedure.
4. syn-Methyl 2-thianapthyl ketoxime was prepared and characterized.
5. anti-Methyl 2-thianapthyl ketoxime was prepared and characterized.
6. The unreported N-acetyl 2-thianapthylamine was prepared and characterized.
7. The unreported phenyl 2-thianapthyl ketone was prepared and characterized.
8. The unreported phenyl 2-thianapthyl ketoxime was prepared.

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