



# ... MICRO-GRAM ...

Vol. I, No. 2

December 1967

## Additional Drugs Under Control

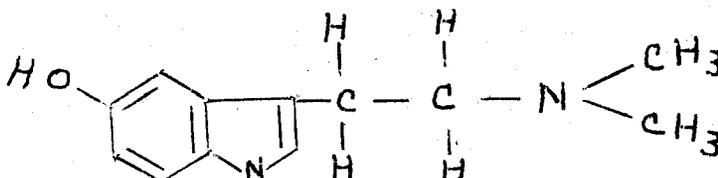
Effective November 22, 1967, Bufotenine and its salts, DET (diethyltryptamine) and its salts, and Ibogaine and its salts were placed under DACA control because of their hallucinogenic effect. (Federal Register, November 3, 1967)

### Bufotenine:

#### A. Chemical and Other Names:

3-( $\beta$ -Dimethylaminoethyl)-5-hydroxyindole  
3-(2-Dimethylaminoethyl)-5-indolol  
N,N-Dimethylserotonin  
5-Hydroxy-N,N-dimethyltryptamine  
Mappine

#### B. Structure:



#### C. Sources:

1. The seeds and pods of Piptadenia peregrina. This shrub is found in the northern parts of South America (Brazil, Columbia) and in the West Indies. It also contains small amounts of dimethyltryptamine (DMT). Certain tribes use the seeds and pods to prepare a snuff called cohobo, niopo, parica or yopo. The snuff is inhaled through a bifurcated tube fitting the nose. The snuff supposedly produces a kind of intoxication during which "visions" are reported to occur. It has also been reported to make the Indians fearless and insensitive to pain.
2. The seeds, pods and bark of Piptadenia macrocarpa. This shrub is also found in South American (Brazil, Argentina) and in the West Indies, and also contains DMT. See further description in 1 above.

**CAUTION:** Use of this publication should be restricted to forensic analysts, or those with a legitimate need.

3. The pods and seeds of Piptadenia excelsa which is found in Argentina and other South American countries also contains DMT. See further description in 1 above.
4. The seeds of Piptadenia colubrina contains bufotenine and DMT and again is found in Brazil and other South American countries. See further description in 1 above.
5. Phalaris tuberosa: This is a perennial grass which was found to contain bufotenine and DMT. A disease in sheep called "stagers" is probably due to the effects of these compounds when the grass is eaten.
6. Dried glandular secretions of certain toad species contain bufotenine. When obtained from this source, it may also be known as Ch'an Su. It has been used for centuries in the treatment of dropsy and, by local application, as a hemostatic (stopping bleeding) probably due to the adrenaline in the powder as well as the bufotenine.
7. Bufotenine has been found to be identical to the substance Mappine which was isolated from the fungus Amanita mappa. It is also present in the fungus Amanita Muscaria but in insufficient quantities to account for the pronounced psychotomimetic effect of this fungus.
8. Bufotenine can also be easily synthesized in the laboratory.

This list is not intended to be an exhaustive source of bufotenine.

D. Physical Properties:

Molecular weight: 204.26. The melting point is 138-140°C. It is almost insoluble in water but is freely soluble in alcohol, less soluble in ether. It is soluble in dilute acids and alkalies. Three salts have been prepared and identified: (a) Methyl iodide: decomposes at 214-215°C.; (b) Monopicrate: which occurs as yellow crystals which change to a red modification at 120-140°C. and then melt at 179-180°C.; (c) Dipicrate: which occurs as red crystals and melt at 176-177°C.

E. Effects in Man:

One study showed that intravenous injections of 8-16 mg. total dose to human volunteers produced primary visual disturbances, alteration of time and space perception and paresthesias. The physiological effects seen were a purple hue to the face, Nystagmus, pupillary dilation and a transient rise in blood pressure. Bufotenine is also capable of causing powerful constriction of smooth muscle thus causing bronchiolar constriction and chest discomfort and constriction of certain blood vessels. The authors state here that after one hour the volunteers appeared to be over the effects.

Another study using schizophrenic subjects showed that intravenous injection of 10 mg. during a 50 second interval produced flushing of the face, hyperventilation and unresponsiveness to stimuli almost immediately. However, in this study no hallucinations were reported by any of the subjects although up to 20 mg. was used intravenously.

A study in immature monkeys who received intravenous doses of either LSD (1.0 mg/kg) or Bufotenine (5.0 mg/kg) showed that both drugs caused gross sensory disorders and a decreased reaction to pain and visual stimuli, but no loss of skeletal muscle power. There is a degree of tameness achieved which allowed the experimenter to easily handle what is usually a vicious animal.

Bufotenine does not appear to be active orally. If the compound is taken as a snuff or intravenously, symptoms will be manifested almost immediately. There is not any concrete evidence as to the duration of action of the compound when taken as a snuff or intravenously.

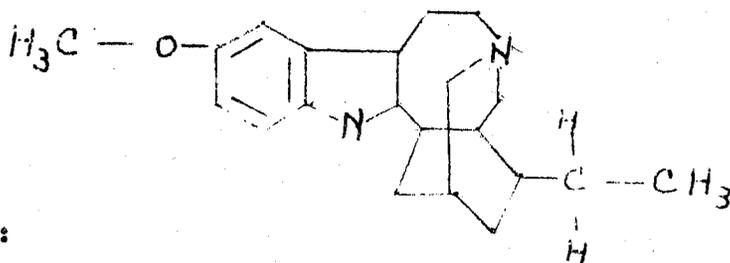
This compound is available from several commercial chemical houses.

### Ibogaine:

#### A. Chemical Name:

7-Ethyl-6, 6a, 7, 8, 9, 10, 12, 13-octahydro-2methoxy-6, 9-methano-5H-pyrido- $\left[1', 2'\right]$ : 1, 2/azepino  $\left[4, 5-b\right]$ indole

#### B. Structure:



#### C. Sources:

1. Root bark, root, stems and leaves of the African shrub Tabernanthe iboga. The shrub contains at least twelve alkaloids of which Ibogaine is one. African natives are said to use the extract while stalking game to enable them to remain motionless for as long as two days while retaining mental alertness. The root is also used to combat fatigue. In high doses excitement, drunkenness, mental confusion, and, possibly, hallucinations are reported in the early literature.

2. Ibogaine can also be synthesized in the laboratory but with difficulty.

#### D. Physical Properties:

Molecular weight: 310.42. The melting point is 152-153°c. Ibogaine

is practically insoluble in water but is soluble in ethanol, ether, chloroform, acetone, and benzene. The Hydrochloride salt occurs as crystals which are soluble in water, methanol, and ethanol and slightly soluble in acetone and chloroform. The salt is practically insoluble in ether.

E. Analysis: See Journal of Criminal Law, Criminology and Police Science, Vol. 58 No. 2

F. Effects in Man:

The behavioral effects of the pure compounds in man have not been reported. However, work in animals has been performed. Two to ten mg/kg. given intravenously to cats or dogs produced almost immediately excitement, dilated pupils, salivation, partial piloerection and a gradually developing picture of rage. The animal hid in the corner of the cage or tried to climb up its walls. These symptoms are at least suggestive of hallucinations. Ataxia also occurred.

In an unanesthetized dog, intravenous injections of Ibogaine cause a rise in blood pressure.

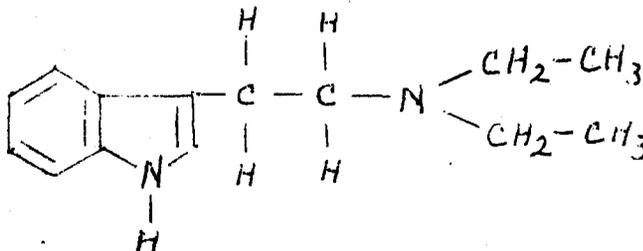
This compound is available from several commercial chemical houses.

Diethyltryptamine:

A. Chemical and Other Names:

DET  
N,N-Diethyltryptamine

B. Structure:



C. Source:

1. DET, in contrast to DMT, has not as yet been found in nature.
2. DET can be easily synthesized in the laboratory.

D. Physical Properties:

DET is an orange oily liquid which is usually smoked on parsley leaves or marihuana. The hydrochloride salt occurs as a crystalline material which is very water soluble.

E. Effects in Humans:

There have been several studies on the biochemical and pharmacological effects of DET. One group administered DET at a dosage of 1 mg/kg (total dose about 60 mg), intramuscularly to ten normal volunteers, and ten chronic schizophrenics. In the normal subjects, the following observations were made: rise of systolic blood pressure, pupillary dilation, slight to severe tremors, visual distortions, dizziness and increased sweating, distortions of time sense, loosening of associative thinking and increased reaction time. The authors concluded from this study that "DET is a powerful, short-acting drug which belongs to the group of drugs variously designated as hallucinogenic, psychedelic, psychotomimetic, or dysleptic." The duration of action of the drug is 2½-3 hours.

In another study, intramuscular doses of DET were employed from 10-150 mg. Optimum effects were reached at approximately 50-60 mg. total dose. The author of this study self-administered the drug and the following is an account of his reaction. The hallucinations consisted of moving, brilliantly colored oriental motifs and later "I saw wonderful scenes altering very rapidly. The faces of the people seemed to be masks. My emotional state was elevated sometimes up to euphoria. At the highest point I had compulsive athetoid (slow, writhing) movements in my left hand. The mask-like faces of the person, the dream-like mysteriousness of the objects and the room gave me a feeling that I had arrived in another world, entirely different and queer and full of secrecy and mystery. This wonderful but strange world attracted me at one moment, but the next moment I did not want to accept it. I became perplexed; I did not know what I ought to do. I began to walk anxiously up and down, and said: 'I ought to do something, I must!' There was a peculiar double orientation in space and time: I knew where I was, but I was inclined to accept this strange world as reality, too. The dusk of the room was lighted for some minutes, and again the light was switched off, and that seemed to me as if this period might be an entire epoch, filled with events and happenings, but at the same time I knew that only several minutes had passed." This particular 'trip' described by the investigator lasted 3 hours.

It is felt that the active compound is actually a metabolite of DET, namely, 6-Hydroxy-N,N-diethyltryptamine (6-HDET). If this compound is given to animals, a picture resembling DET is obtained. In a study where 6-HDET was administered to a human, the author came to the conclusion that this compound is five to six times more active psychotropically than DET.

DET does not appear to be active orally.

This compound is available from several commercial chemical houses.  
DMT (Dimethyltryptamine)

Three American chemists, Fish, Johnson, and Horning, in the Journal of American Society 77, 5892 (1955) reported finding N,N-dimethyltryptamine, DMT, together with Bufotenin in snuff prepared from the seeds of Piptadenia peregrina used by Haitian natives in religious ceremonies. Dr. Steven I. Szara later synthesized DMT and found it to be an hallucinogenic.

DMT is not known to be active orally. The abuser usually inhales it from smoke vapors after having applied it to tobacco, ground-up parsley leaves, or marijuana. The effects of one deep inhalation is reported to last up to thirty minutes. DMT primarily causes visual hallucinations. The rapid on-set and overwhelming loss of control can cause panic reactions faster than the known, longer-lasting hallucinogens. Most of the DMT encountered in the illicit traffic in the United States is produced in clandestine laboratories. Abusers have not been found to inject DMT intramuscularly, possibly due to the fact that they are concerned with contamination from other compounds which may be produced during the clandestine synthesis. In medical research that has been done on DMT the drug has been injected intramuscularly; the average dose being 150 milligrams. When injected, DMT begins to take effect within five minutes and the effects can last approximately one hour. DMT comes under the purview of the Drug Abuse Control Amendments of the Federal Food, Drug and Cosmetic Act.

Methods of analysis for DMT & DET are attached.

#### BDAC Micro-Gram

The reaction to our first issue of Micro-Gram was most gratifying. We appreciate the many excellent comments and suggestions. Most of these you will see reflected in future issues of Micro-Gram.

#### Communicate

If you have information which you think other crime laboratories should know, send it to us. If we can, we'll print it in Micro-Gram under your by line and everyone will benefit.

#### Clinitest Tablets

These tablets, manufactured by Ames Company, Inc., Elkhart, Indiana, are intended to test urine for glycosuria. They contain copper sulfate, sodium hydroxide and heat producing agents. A "hippie", believed to be psychotic, was passing these tablets out in California.

#### Tranquinal

Reported in the "hippie" press to be a "come down" for STP "freakouts". Manufactured by Barnes-Hind Labs, Inc., Sunnyvale, California. Contains: Acetylcarbromal, bromisovalum, and scopolamine aminoxide Hbr.

Sominex

An over-the-counter sedative containing scopolamine. Apparently being occasionally abused. Produced by J. B. Williams Co., Pharmaceuticals Div., New York, New York.

Asthmador

This is produced by the R. Schiffman Co., Los Angeles, California, and is intended for the relief of asthma symptoms. It is also known by the Canadian trade name "Aznador". The primary active ingredients are scopolamine and atropine, from Datura Stramonium and Atropa belladonna plants.

Asthmador is available in powder form, in cigarettes and in pipe tobacco. Similar substances such as Braters Powder, Dr. Gulids Green Mountain Asthmatic Compound, Dr. Kinsmans Asthmatic Powder, and Haywood's Powder are produced by other manufacturers. None of these compounds require a prescription.

We have had many reports of teenagers ingesting asthmador in coke, tea, coffee, beer, water or in capsules which they make themselves. All reports indicate that hospitalization of the individual was required. No fatalities have been reported.

If you have any knowledge of the misuse or abuse of any of these products, please forward it to BDAC's Division of Drug Studies and Statistics.

More on STP

For the latest on STP, we suggest that you read "Science", 158:669,1967.

In the last issue of "Micro-Gram", we reported that Thorazine was contra-indicated on the treatment of "STP freakouts". According to early reports, Thorazine potentiated the adverse symptoms of STP. We understand that this is not the case. Apparently, the increasingly bad effects reported in early cases were actually due to Thorazine toxicity which resulted from continued overdosing.

LSD

Procedures for the analysis for LSD by Thomas G. Alexander, Division of Pharmaceutical Chemistry are attached.

Analysis and Identification of:  
Dimethyltryptamine (DMT), Diethyltryptamine (DET)

Usual Dosage Forms,

Usual Concentrations

Capsules

50 - 70 mg/cap.

On parsley leaves

2 - 10 mg./gm.

METHOD: I. (Use method II if DMT or DET is on parsley leaves.)

Put into a separatory funnel a 20 mg portion of the powdered sample material. Dissolve the dimethyltryptamine base in 20 ml of 1% NaHCO<sub>3</sub> solution. Extract the DMT with 5 x 20 ml portions of CHCl<sub>3</sub>, filtering each CHCl<sub>3</sub> extract through a pledget of cotton into a 100 ml volumetric flask. Adjust the final volume to 100.0 ml with CHCl<sub>3</sub>.

Evaporate a 10.0 ml aliquot of the CHCl<sub>3</sub> extract to dryness with a current of air, avoid using any heat.

Dissolve the residue in alcohol and dilute to 100.0 ml. with alcohol. Prepare a DMT std. to contain a 2 mg of DMT/100 ml of alcohol. Scan the spectra of the sample and std. from 320-240 m $\mu$  using alcohol as a blank on a suitable recording spectrophotometer. Measure the maximum absorbance of the sample and std., occurring at ca 282 m $\mu$ , and determine the amount of DMT present in the sample.

DMT exhibits maxima at ca 290 m $\mu$ , 282 m $\mu$ , and 276 m $\mu$  and minima at ca 287 and 278 m $\mu$ .

METHOD II. DMT OR DET ON PARSLEY LEAVES

Preparation of Column:

Put activated florisil in a chromatographic column (18 mm id) to a height of ca three (3) inches. Cover with a small pledget of glass wool. Pre-wet column with approximately 20 ml of benzene.

Standard:

Dimethyltryptamine - 2 mg/100 ml in alcohol

Diethyltryptamine - 2 mg/100 ml in alcohol

Procedure:

Accurately weigh ca 1 gm of parsley leaves into a 50 ml glass stoppered flask or graduate cylinder. Extract by shaking with three successive 25 ml portions of benzene. Pour each extract on the florisil column; catch the eluate in a 100 ml beaker. Evaporate the benzene on a steam bath with the aid of a current of air. Dissolve the residue in alcohol and dilute to 100.0 ml. Scan sample and standard from 250 m $\mu$  to 350 m $\mu$  on a recording spectrophotometer. DMT has a maximum at ca 282 m $\mu$ .

IDENTIFICATION BY THIN LAYER CHROMATOGRAPHY

For Method I. (For Method II. Evaporate a few mls. of the alcohol solve. to dryness and proceed accordingly).

If the analysis shows that the CHCl<sub>3</sub> extract of the sample contains more than 0.5 mg/ml of DMT; a 10 - 20  $\mu$ l aliquot can be spotted on the plate.

If less than 0.5 mg/ml is found, evaporate to dryness ca 1 ml of the CHCl<sub>3</sub> extract of the sample with the aid of a current of air. Dissolve the residue in a minimum amount of CHCl<sub>3</sub> and spot the entire soln. on a silica gel G-water plate. At the same time spot the equivalent of 50-200  $\mu$ g. of DMT std. in CHCl<sub>3</sub>. Similar concentrations of LSD and Diethyltryptamine (DET) can be spotted on the same plate.

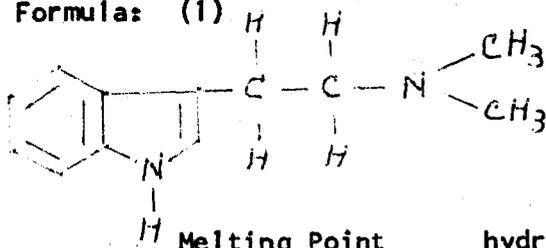
After the spots have air dried, (1-2 min), put the plate in a developing tank. Use as the mobile solvent 4:1 mixture of alcohol/NH<sub>4</sub>OH (1 3).

Allow the solvent front to rise 10 cm above the point of application.

Remove the plate and air dry ca 5 minutes. Spray the plate with a mixture of 10:10:20-40% formaldehyde soln: (1 3 ) HCL:alcohol. Heat the plate at 100°C for 5-7 min. Yellowish brown spots appear which under long wavelength (ca 3660 Å) UV light will fluoresce in the yellow-orange-green region. The Rf value for DMT is ca. 0.60. DET will fluoresce the same as DMT and has an Rf value of ca 0.45. LSD fluoresces blue under long wavelength UV light and has an Rf value of ca 0.75. As little as 0.4 ug of DMT will readily fluoresce under long wavelength UV light.

Compound Name: DMT; N,N Dimethyltryptamine; Indole-3(2 aminoethyl)  
N,N Dimethyl

Structural Formula: (1)



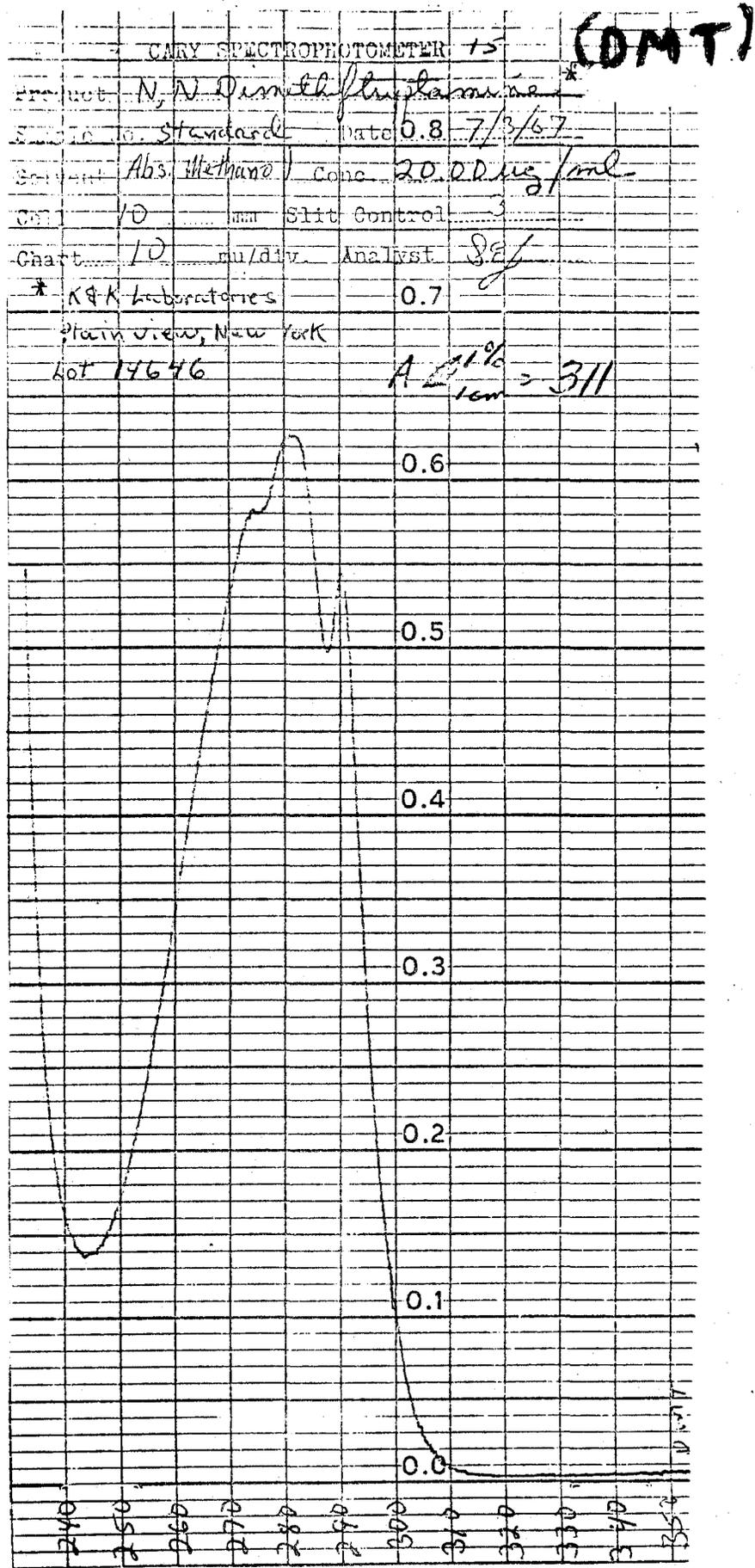
C<sub>12</sub>H<sub>16</sub>N<sub>2</sub>

Melting Point

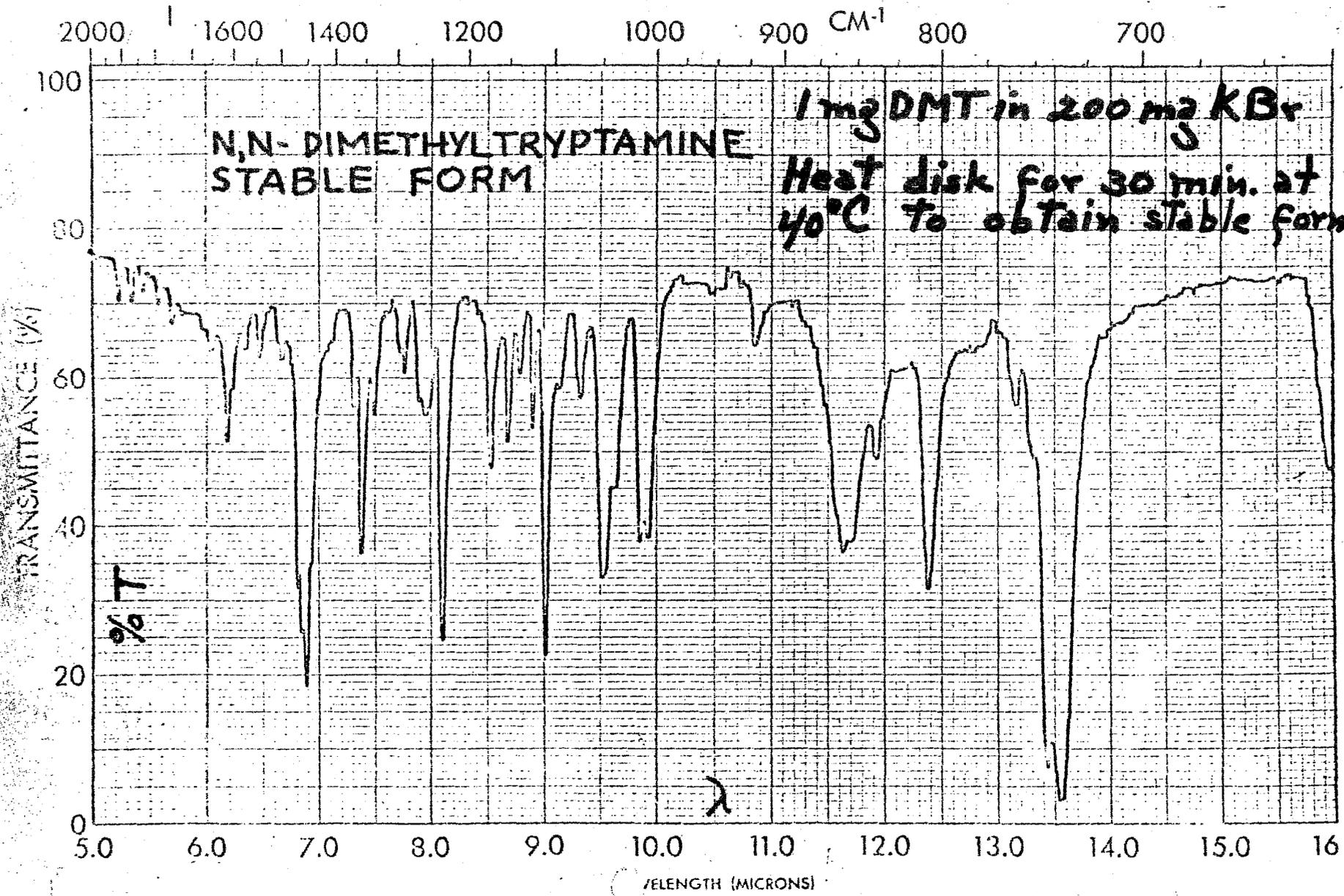
hydrate	48-49
picrate	170
iodide derivative	216-217

Ultraviolet Data: See attached spectra for DMT and DET.

Infrared Data: See attached spectra for DMT and DET.

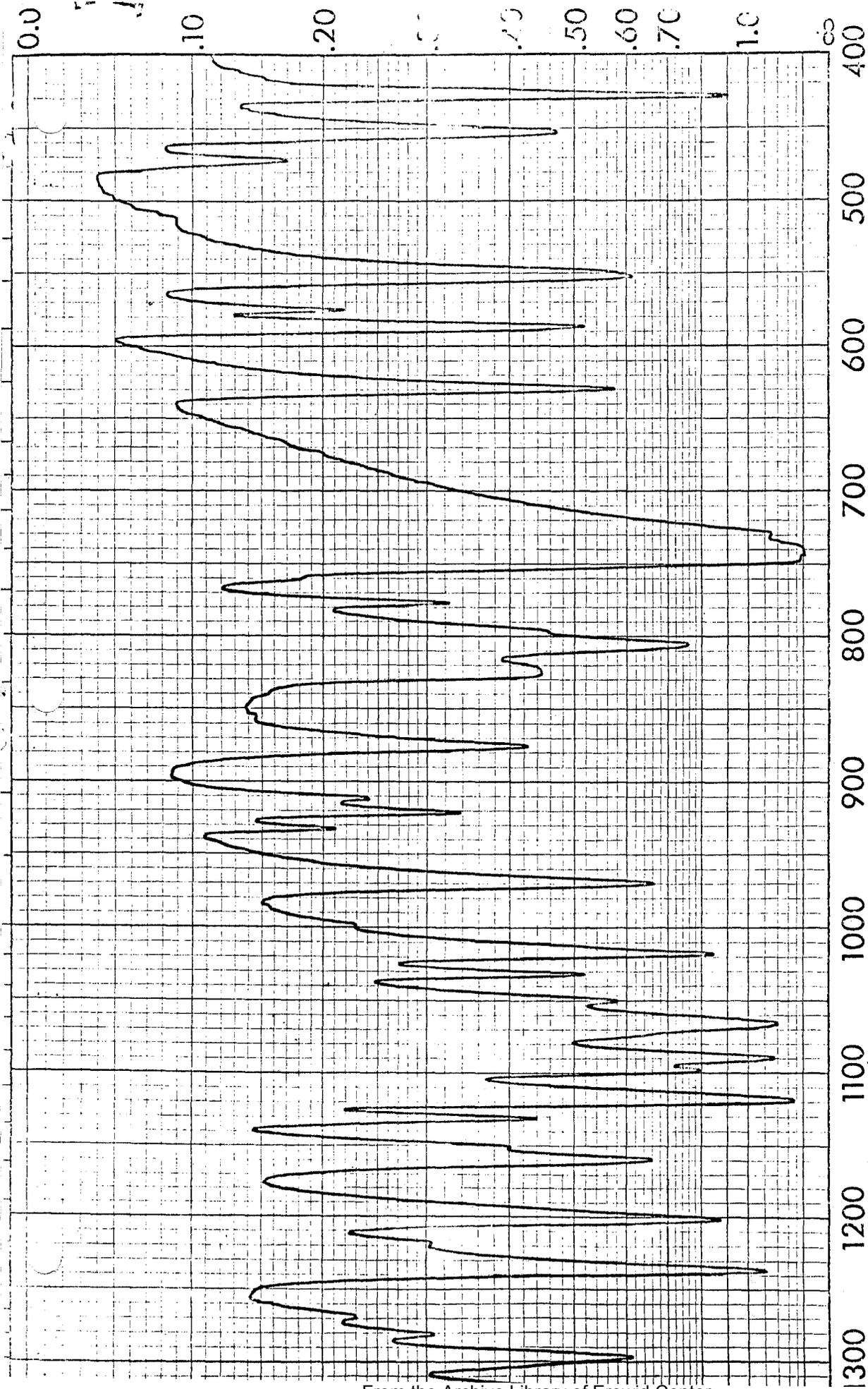


12



2 to 5  $\lambda$  - No significant peaks

9



FREQUENCY (CM<sup>-1</sup>)

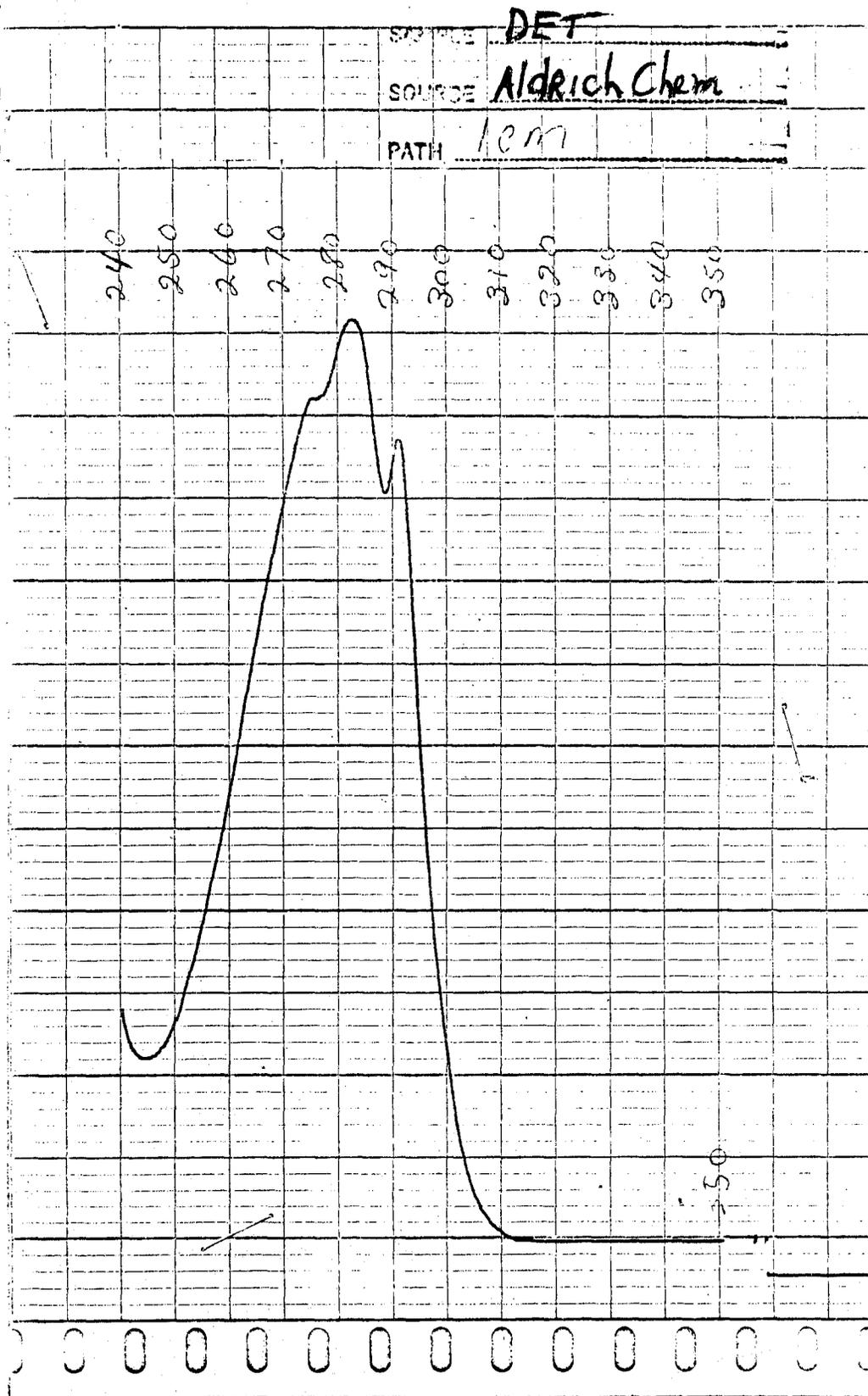
SAMPLE <u>DET</u> RIGIN <u>Alkyl Chemical</u> ANALYST <u>K-1340</u>	CURVE NO. _____ CONC. <u>1mg / 200mg KBr</u> CELL PATH _____ REFERENCE _____	SCAN SPEED <u>Slow</u> SLIT _____ REMARKS _____	OPERATOR <u>GLH</u> DATE <u>8-9-67</u>
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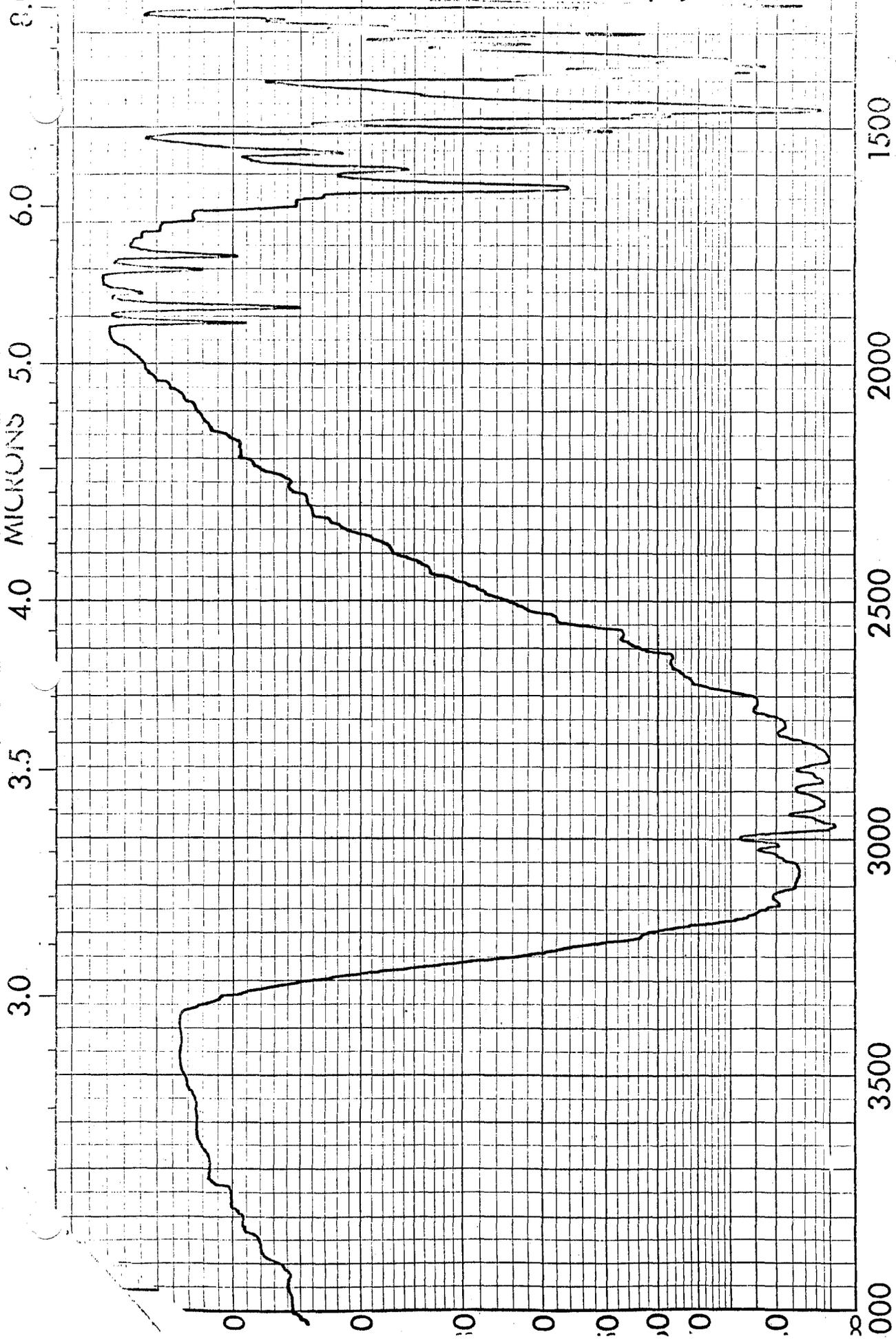
2

CARY INSTRUMENTS, MONROVIA, CALIFORNIA

CHART No. 1400

PRINTED IN U.S.A.





SAMPLE <u>DET</u>	CURVE NO.	SCAN SPEED <u>Slow</u>	OPERATOR <u>64H</u>
ORIGIN <u>Alkrich Chemicals</u>	CONC. <u>1mg / 200mg KBr</u>	SUIT	DATE <u>8-9-67</u>
	CELL PATH	REMARKS	

LABORATORY INFORMATION BULLETIN

Bureau of Science  
January 27, 1967

No. 141A  
Drug Analysis

PROCEDURES FOR THE ANALYSIS OF LSD PREPARATIONS

Thomas G. Alexander  
Division of Pharmaceutical Chemistry

A method is described for sample preparation and subsequent qualitative and quantitative analysis of N,N-diethyl-d-lysergamide (LSD). In addition, descriptions of alternative procedures are included. The analyst is advised to select the particular procedures on the basis of the amount of sample available, the form of the sample, the equipment at hand, and time considerations.

Samples which are suspected of being pure LSD, or one of its salts, do not require extraction. In fact, more useful information can be obtained regarding the integrity of the sample by performing the qualitative and quantitative tests directly on the sample.

Sample Preparation

(Use water-saturated solvents throughout)

1. Preparation of Bicarbonate Column -

Perform the following in a 400-ml. beaker:

- a. Solids - triturate a portion equivalent to one to five mg. with five ml. of 1% tartaric acid for ten minutes.
- b. Volatile Organic Liquids - evaporate a portion equivalent to one to five mg. in a current of air to dryness, or until only residual droplets of water remain. Dissolve the residue in five ml. of 1% tartaric acid.
- c. Aqueous Liquids - Dilute a portion equivalent to one to five mg. to five ml. If the volume representing one mg. is greater than five ml., proceed as directed in the alternative extraction procedure, except pass the extracts onto the citric acid columns described below.

To the sample add three ml. of chloroform and one gm. of  $\text{NaHCO}_3$ . Mix. Check to assure that the aqueous layer is alkaline. (From this point, proceed without delay.) Add sufficient acid-washed Celite 545 to make a fluffy mixture (10 gm) and pack firmly in a 25 x 300 mm chromatographic tube. Complete the transfer with small amounts of chloroform and celite. Cover with a glass wool wad. Column III.

## 2. Preparation of Citric Acid Columns -

Mix three ml. of 2% citric acid with four gm. of celite and pack firmly in a 25 x 250 mm chromatographic tube. Place a mixture of two ml. of water and two gm. of celite above the acid layer. Column I.

Prepare another trap column (column II) as above, using three ml. of 8% citric acid solution and four gm. of celite.

## 3. Procedure -

Place the columns so that the effluent from the carbonate column (III) passes onto the 2% column (I), and the effluent from that onto the 8% column (II). Add 50 ml. of  $\text{CHCl}_3$  to the top column to separate the alkaloid-like substances from the water-soluble materials. Wash column I with 50 ml. of  $\text{CHCl}_3$  to move the LSD onto column II (iso-LSD will be retained on the 2% column (I)). Then wash column II with 25 ml. of  $\text{CHCl}_3$ .

Check to see that the columns are properly retaining the alkaloids. 100 mcg, or more, of LSD or iso-LSD can be detected on the column by fluorescence under ultraviolet light. The LSD and iso-LSD appear as blue rings on the citric acid layers.

Note: The appearance of blue fluorescent bands on both of the citric acid columns constitutes tentative identification of an LSD preparation. Illicit samples usually contain mixtures of LSD and iso-LSD.

## 4. Recovery of the "Alkaloids" -

Extrude the acidic columns into 400-ml. beakers by applying air pressure at the column tips. Render alkaline with  $\text{NaHCO}_3$ . Wash the mixtures with water into 250-ml. separators. Extract with 10-ml., 5-ml., and 5-ml. portions of chloroform through glass wool into 25-ml. volumetric flasks.

### Alternative Extraction Procedure

This simpler method does not separate LSD and iso-LSD, but is more rapid than the column chromatographic method and may be preferred for small quantities, since there are fewer steps involved. These methods are based on one mg. sample size. If less than one mg. is available, it is suggested that proportionately smaller volumes of solutions and solvents be used.

#### 1. Preparation of Aqueous Solution -

Perform the following in a 200-ml. separator:

- a. Aqueous Liquid - dilute a portion equivalent to one mg. to 50 ml. with water.
- b. Sugar Cubes - dissolve a portion equivalent to one mg. in 50 ml. of 1% tartaric acid solution.
- c. Gelatin Capsules Containing Sodium Bicarbonate - LSD Mixture - empty contents of capsule into the separator. Wash inside of capsule with 1% tartaric acid solution and empty into the separator. Dilute to 50 ml. with the acid solution. Mix well and, if necessary, acidify to pH-4 with HCl.
- d. Volatile, Nonaqueous Liquids - in a beaker, evaporate a portion equivalent to one mg. to dryness, or until only aqueous residues remain. Dissolve in 50 ml. of 1% tartaric acid solution and transfer quantitatively to a separator.

#### 2. Extraction -

Add 10 ml. of chloroform to the tartaric acid solution, render basic with  $\text{NaHCO}_3$  and mix. Filter the organic layer through glass wool into a 50-ml. volumetric flask. Extract with three additional 10-ml. portions of chloroform and dilute to volume with chloroform.

### Identification

#### 1. Thin-Layer Chromatography -

Evaporate the final chloroform extracts, or an aliquot therefrom, to a concentration of five mg./ml., without heating above room temperature. Spot 1-10  $\mu\text{g}$ . on silica gel G. plates and develop

with a chloroform-acetone (1:4) solution. LSD should appear at  $R_f=0.4 - 0.5$  and iso-LSD at  $0.1 - 0.2$  as bright blue fluorescent spots under long wavelength ultraviolet light. On chromatograms of partially deteriorated samples, several extraneous spots will be observed:

<u><math>R_f</math></u>	<u>Color (fluorescence)</u>
0	brown
0.05	tan
0.25	yellowish green
0.5, immediately ahead of LSD	yellow
0.8	red

(All of the above described spots may not be detected, and there may be others; therefore, these data cannot be used as a rigid guideline.)

For more certain identification, particularly if an infrared spectrum is not available, a second chromatogram should be run using a different system. The use of acetone and silica-alumina plates is suggested. These plates are prepared from two separate slurries, one of Silica Gel G, and one of alumina, each containing the same weight of absorbant. The slurries are mixed and then spread on the plates.

## 2. Infrared Spectrum -

Use extracts which contain pure alkaloids, as indicated by TLC. Evaporate an aliquot representing one mg. to dryness under a current of nitrogen in a mortar. If necessary, dry in a desiccator to get rid of water. Dissolve the residue in one ml. of dry chloroform. Add three ml. of n-heptane. Again evaporate to dryness under a current of nitrogen. Add and mix 200 mg. of KBr. Press into a disc and scan from 2 to 15  $\mu$ . When comparing the spectrum to that of a standard, be sure that the standard is also in the base form and treated in the same manner.

## 3. Gas-Liquid Chromatography -

For a very sensitive identification method, the analyst is referred to the recent article by Radecka and Nigam (J. Pharm. Sci., 55, 861 (1966)). These authors found it necessary to hydrogenate the LSD prior to injection. Presumably, the sensitivity would be much enhanced by having the total flow directed to the detector.