Item ID Number 04911 ☐ **Not Scanned**

Author

Corporate Author

Report/Article Title FAA Terminal Radar Approach Control (TRACON), Dioxin Advisory Group and Consultation, 1980

Journal/Book Title

Year 0000

Month/Day

Color ☐

Number of Images 404

Description Notes Alvin Young served as a consultant to the Federal Aviation Administration when dioxin was found in samples of gases emitted from a plant located near the FAA's TRACON facility at Hempstead, Long Island, NY.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

APR 4 1980

Mr. Murray E. Smith, Director
Eastern Region
Federal Aviation Administration
Federal Building
John F. Kennedy International Airport
Jamaica, New York 11430

Dear ~~Mr. Smith~~: Murray

As you are now aware from the meeting held on March 31, 1980 in your office, EPA has received the results from sampling the Hempstead Resources Recovery Corporation plant in Garden City, New York. In addition to the emissions characterization previously described to you, we also had several of the samples analyzed for tetrachlorodibenzodioxin (TCDD). As we discussed with you the results showed TCDD in the stack gas.

We are presently taking advantage of the fact that the plant is temporarily closed to investigate what improvements to the combustion process may be possible and to design a detailed sampling program to determine the cause and significance of the TCDD. An informal work group of state, local and federal officials has been formed for this purpose.

Attached please find a copy of the sampling results at the Hempstead plant. There is a draft report by the Midwest Research Institute, a draft report by Northrop Services, Inc. and a letter from Wright State University presenting the first TCDD analytical results.

We will keep you informed of progress on this project and will send written information as it becomes available.

Sincerely yours,

Charles S. Warren
Regional Administrator

Attachment

SUMMARY

The U.S. Environmental Protection Agency's Fuels Technology Branch in Cincinnati is currently supporting a research program to conduct environmental assessments of various types of waste-to-energy conversion systems. Under the auspices of this program, Midwest Research Institute, in conjunction with the Surveillance and Analysis and Air ~~Facilities~~ and Hazardous Materials Divisions of EPA Region II, conducted an emission evaluation of the Hempstead Resource Recovery Plant in Westbury, Long Island, New York. The purpose of the study was to environmentally characterize the air emissions and solid effluents emanating from the powerhouse portion of the refuse conversion facility.

Tests were conducted on the No. 2 unit of the powerhouse, which is an air-swept spreader stoker boiler with a nominal capacity of 200,000 lb/hr of steam. The boiler was fired with 100% refuse-derived fuel from the adjoining processing plant (Black Clawson Hydrasposal process). Steam generated by the boiler powered an electric turbine generator rated at 20 MW and the electricity thus produced was sold to the local utility company. Air pollution controls for the boiler consist of a bank of 12 mechanical cyclones followed by an electrostatic precipitator.

Emission streams which were evaluated included boiler bottom ash, cyclone ash, ESP ash, and the stack effluent. The three ash streams were analyzed for their elemental composition. Stack emissions were continuously monitored for SO_2, NO_x, CO, O_2, and total hydrocarbon concentrations, and were also tested to determine levels of vaporous mercury and aldehydes. In addition, a test was conducted using the EPA Source Assessment Sampling System for analysis under EPA's Level 1 protocol. A gas chromatography/mass spectroscopy analytical procedure was added to the Level 1 protocol to further define organic pollutants in the stack gases.

Results of the test program did not indicate any pollutant emissions of major concern. Stack gases contained relatively low concentrations of SO_2, NO_x, and hydrocarbons. Carbon monoxide levels were slightly greater than anticipated.

Emissions of carbonyl compounds (aldehydes) were detected at a maximum level of 7 ppm IN THE STACK (6.5 lb/hr), which is not a cause for environmental concern. If the aldehyde compound is formaldehyde, then this value of 7 ppm would be above the odor threshold.

Mercury vapor concentrations in the stack effluent were very low (< 0.12 mg/m^3), and it appears that mercury levels are greatest in the fly ash collected by the electrostatic precipitator. The concentration of mercury in samples of the RDF was constant at about 3 μg/g.

Several trace metals were detected in the stack gases at high concentrations. Of these, lead, antimony, chromium, and arsenic were most notable. Their respective concentrations in the SASS sample were 580, 460, 640, and 560 $\mu g/m^3$. Elemental analysis of the bottom ash, cyclone ash, and ESP ash streams also indicated that many of the more volatile elements were associated with the smaller sized particles.

Organic analysis of the SASS sample, using EPA Level 1 and additional GC/MS analytical techniques, showed a variety of organic constituents. No single compound group appeared to predominate, although several polynuclear aromatic hydrocarbons were detected. All organic results were qualitative.

Compounds consistently observed in all SASS component extracts included naphthalene, fluoranthene, acenaphthylene, pyrene, phenanthrene/anthracene, bis(2-ethylhexyl) phthalate, and diphenylamine. The majority of additional compounds were found in the XAD-2 resin extract and included two chlorobenzenes, hexachlorobenzene, fluorene, and di-butylphthalate.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

APR 13 1984

George Lathrop, M.D., Ph.D.
Chief, Epidemiology Division
U. S. Air Force, School of
Aviation Medicine
Brooks Air Force Base
Texas 78235

Dear Doctor Lathrop:

This is in confirmation of our recent telephone conversation concerning the report of dioxin emissions from a resource recovery plant at Hempstead, Long Island, New York, and the impact of these emissions on a Federal Aviation Administration (FAA) Terminal Radar Approach Control (TRACON) facility that is adjacent to the plant.

Mr. Langhorne Bond, Administrator of the FAA has requested that I obtain the assistance of recognized experts to advise the agency on this matter and recommend possible action to the FAA.

To achieve this, I request the assistance of Major Alvin Young of your staff. For the present, I anticipate that Major Young's contribution will involve review of background information relative to the dioxin emissions and attendance at a one-day meeting in New York at our regional office. This meeting would allow for the discussion of reviewed information with other experts, on-site inspection of the recovery plant and the TRACON facility, and the formulation of recommendations. It is anticipated that other than the single meeting in New York, the work of the group of experts can be carried out through written correspondence and by telephone.

All travel and transportation expenses related to this meeting will be borne by the FAA. We will provide Travel Orders and an airline ticket for Major Young's use. Background information and further details on this meeting will be directed to Major Young through your office.

Your support of this effort is appreciated.

Sincerely,

JOHN T. JOBAVI, M.D.
Deputy Federal Air Surgeon
Office of Aviation Medicine

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

APR 7 1980

Received
16 APR 1980
AM

Major Alvin Young, Ph.D.
c/o George Lathrop, M.D., Ph.D.
Chief, Epidemiology Division
USAF SAM
Brooks Air Force Base, Texas 78235

Dear Major Young:

As indicated to Dr. George Lathrop in my letter of April 16, Mr. Langhorne Bond, Administrator of the Federal Aviation Administration (FAA), has asked me to obtain the assistance of recognized experts to advise the agency on the potential toxic effects of dioxin.

The need for this advice has developed because dioxin has been found in samples of gases emitted from a resources recovery plant that is located adjacent to the FAA's Terminal Radar Approach Control (TRACON) Facility at Hempstead, Long Island. Although a gas sample was taken by the Environmental Protection Agency (EPA) in July 1979, the finding of dioxin was not disclosed until March 1980. According to EPA, a subsequent sample was taken in August 1979, but the results of this sample are not yet available.

The resources recovery plant is not operating at the present time because of a labor dispute, and we do not know when it will resume operations. We are advised that EPA will obtain soil and water samples at the TRACON within the next week to evaluate for dioxin levels, but a protocol for conducting additional studies is not available. EPA has been unwilling to definitively advise the FAA whether a health hazard exists for employees at the TRACON.

Until information can be developed that will permit a decision in respect to potential health hazards to our employees at the TRACON, the FAA has elected to staff the facility with volunteers only. This temporary measure may be expected to impede operations of the facility.

Enclosed for your review is a copy of the selected material regarding emissions from the resources recovery plant, a brochure on the plant, and miscellaneous correspondence concerning the finding of dioxin. In addition to you, I have asked Dr. B. Mason Hughes, Gulf South Research Institute, New Orleans, Louisiana; Dr. Renate Kimbrough, Center for Disease Control, Atlanta, Georgia; and Dr. Walter Melvin, Colorado State University, Ft. Collins, Colorado, to review this information and advise the FAA.

I would like to convene a meeting of this group of experts at our Regional headquarters in Jamaica, New York, at 9:00 a.m. Friday, April 25. This meeting will allow for the discussion of the reviewed information, on-site inspection of the recovery plant and the TRACON facility, and the formulation of recommendations. After you have had the opportunity to review the enclosed information, I will contact you by telephone to further discuss this problem and provide specific details on the meeting in New York.

If you have any questions, please contact me at area code 202 426-3537.

Sincerely,

JON L. JORDAN, M.D.
Deputy Federal Air Surgeon
Office of Aviation Medicine

Enclosures

DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235

18 April 1980

REPLY TO ATTN OF: EK

SUBJECT: Support to the FAA

TO: SAM/CE
SAM/CD
SAM/CC
IN TURN

As indicated by the attached letters, Dr. Jordan is soliciting the assistance of Maj Young in the resolution of their problem. Dr. Jordan was steered to us by the Surgeon General's Office who verbally concur with the FAA request. I have given Dr. Jordan tentative approval for Maj Young's services provided that they do not impact mission requirements of this organization or incur the disapproval of anyone in the Command system below the Surgeon's Office.

GEORGE D. LATHROP, Col, USAF, MC
Chief, Epidemiology Division

2 Atch
1. FAA Ltr, 16 Apr 80
2. FAA Ltr, 17 Apr 80

Cy to: AMD/SG
AFSC/SGP (Lt Col Burnett)

TDY SCHEDULE
Major Young

24-26 April 1980

PURPOSE: To provide consultative support to FAA on dioxins

24 Apr 80

0735 Depart SAT BN 18
1330 Arrive JFK, New York

Quarters: Howard Johnson Motor Lodge
135-30 140th St.
Jamaica, NY
Phone: 212-659-6000

Thursday afternoon: Tour Hempstead Resources Recovery Incineration Plant, Garden City NY
Host: Mr John D'Abrosia

25 Apr 80

0900 Attend Task Force Meeting at FAA Regional Headquarters, Jamaica NY, participate in on-site inspection of TRACON Facility and formulate recommendation.
Host: Dr Jon L. Jordan
(Emergency contact via 202-426-3537)

26 Apr 80

0700 Depart JFK Airport DL 241
1230 Arrive SAT

April 25, 1980

0915: Murray Smith, Regional Director FAA
TRACON Facility Vital to Air Traffic Control Program in Northeast USA.

Problem: 2nd week in May, a training program is to be initiated at TRACON. FAA will not permit their people to work at TRACON if there is a major health problem.
Two points: What to do now - residual levels present?
What to do when the plant starts up?

Location of an old Air Base - (Mitchel Field).

Dr. Jon Jordan
Goal
- Health Aspects re: employees
- Monitoring Requirements
- Chemistry

Established an Advisory Committee of Experts.

Mr Bob Ogg - EPA (Asked to Provide Background)
Steve Levy

HRRC - Dry wastes are introduced into a wet slurry form, separated and the organic fraction is "dewatered". This "dry" fraction is used in a combustion

Dr. Jordan
4-23-80

1. Based on presently available information concerning dioxin emissions from HRRC:

   a. Have FAA employees who were working at the TRACON while the HRRC was in operation been exposed to a significant health hazard? If so, what is this hazard and are there any special medical studies that should be conducted now or in the future?

   WE don't Know

   b. Is it hazardous for FAA employees to continue to work at the TRACON now, while the HRRC is not functioning? Should any special health studies be conducted on employees who continue to work at the facility and if so, what should these studies include?

   Screening & Health Records
   Skin Screening

   yes.

   c. Should sampling studies to measure possible environmental contamination from dioxin be conducted now and, if so, what studies are suggested? With appropriate controls!

   d. If the HRCC resumes operation, what health risk, if any, would be incurred by FAA employees who continue to work at the FAA TRACON? If it runs under ideal conditions (contrary to experience).

   Sensitive indicator

   e. If the HRCC resumes operation and FAA employees continue to work at this TRACON, what special health studies, if any, should be conducted by the FAA?

   Baseline Physical

   f. If the HRRC resumes operation, what sampling studies should be conducted to measure dioxin concentrations in emission and dioxin contamination of the environment around this TRACON?

EPA should be strongly encouraged to conduct [redacted]ntal samples.

Other agencies conducting long-term studies. Results should be made to you

problem: Rated to handle 700,000 Tons of refuse per day. Two boilers.

Theoretical
Dwell Time ~ 2.5 sec.

Task 1. July 79. Total Organics Northrop Services Incorp.
Task 2. Aug 79. Midwest Research Institute

Characterization of Organics
Both Tasks identified tri-chlorophenol
This promoted a request from EPA

Portion is the condensable portion. Probe after electrostatic precipitator. Results are of impinger trap extracts

MRI - 8 Samples:

Analysis of Condensate	Resin Column
1	
2	
3	
4	

- DEFINE OUR TASK

Problems

- Characterize emissions
- Do the levels of these emissions constitute a health problem?
  - + Are these decking/fumes in/on the premise?
  - + What is the estimated exposure level?

Literature

8 RAPPE AND BUSER
5 KIMBLE AND GROSS
6 LANGER, BRADY & BRIGGS
2 DOW CHEMICAL - CHEMISTRY OF FIRES
3 EICEMAN, CLEMENT & KRAUSKE
7 PLUMMER
1 DOBBS
4 JANSSON / SUNDSTRÖM

Arrive 1430 Tracon Facility — EPA Dave J. Cesaro

Ross Halpern

EPA Personnel were collecting environmental sample!

Soil. 1 Sample — Six locations

2 x 3 Subsamples

x	x	x

At each location. Top 1" containing vegetation is removed and soil shook onto AL foil. Two additional inches removed and all soil composited and placed in a common bottle ~1 lb of soil.

Air Filters — Aug/Sept 78 - Incinerator Plant begin operation

Roof Drainage - All tie into common locations & onto Concrete splash blocks

Parking Lot -

Loading Dock -

- Other Chemicals & [illegible] AA Problems
- Physical Examination: – Dr Taylor
  – Dr Suskind
  – Dr Birmingham

* Skin Screening – 40

– Introduction
– Task of Advisory Team
– Brief Literature Review
– Observations & Discussion. Smell
– Recommendations
– Literature Cited

Seat Belts

- List of Awards

Exposure Function TD4
FAA TD4.

Depart 24 Apr.

0735 - 1330

→ BN 18

Delta 241

[redacted]

21 Apr 80

Dr Melvin: Will Call Mason Hughes

- Problem needs to be defined
- Erratic Behavior of the boiler
  750 °C — Repeat Study MRI
  fuel/air Temp.
  Dwell Time
  — 3 isomers of trichlorophenol.
- Soil Sampling — Meaning?
- Protocol for Environmental Monitoring
- NOT FAA Problem — Broade-Scoped

21 Apr 80 1300 Hr

Dr Hughes

- Isomers of dioxins / Furans.
- Must know more about incinerator -
  Type of trash
  Combustion Operations
- Position of EPA unclear
- Prepare to address chemistry with Pat O'Keefe.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

MAY 2 1980

Major Alvin Young, Ph.D.
United States Air Force
School of Aviation Medicine
Brooks Air Force Base, Texas 78235

Dear Major Young:

Enclosed for your review is a draft of the report of the FAA Dioxin Advisory Team that met at the agency's regional office in Jamaica, New York. Also enclosed is a copy of the rough draft report that was prepared by several of the group on the evening of April 25.

As you can see, editorial information has been added and the organization of the draft report has been modified. I have tried not to change the substance of the recommendations and conclusions, and hopefully, I have succeeded.

Please review the draft report and feel free to make modifications, additions, or deletions as you consider appropriate. Appendices I, V, and VI are not included. If you have not provided me with your biographical sketch, please do so at the earliest opportunity. Appendix VI (TRACON plat) will be added when it can be photographically reduced to a manageable size. If you have any questions or suggestions that may be handled by telephone, please feel free to call me at area code 202-426-3535.

I wish to again express my appreciation for your assistance in this matter. I cannot overemphasize the importance to the FAA of a prompt and judicious resolution of this problem.

Sincerely,

JON L. JORDAN, M.D.
Deputy Federal Air Surgeon

Enclosures

DRAFT

Report of the FAA

Dioxin Advisory Team

May 1, 1980

I. INTRODUCTION

On Friday, March 21, Newsday, a New York newspaper, published a report that dioxin had been found in emissions from a resources recovery plant in Garden City, New York. This information had impact on the Federal Aviation Administration (FAA) because the agency's new Terminal Radar Approach Control (TRACON) Facility in Garden City is located adjacent to the recovery plant.

Although the FAA had had previous correspondence and contact with management of the recovery facility (Hempstead Resources Recovery Corporation (HRRC)), the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) concerning adverse environmental effects produced by operation of the HRRC facility, the presence of dioxin in the emissions was unknown prior to publication in Newsday. The finding of tetrachlorodibenzodioxin (TCDD) was later confirmed to FAA by USEPA and a copy of a report of environmental assessment prepared by the Midwest Research Institute containing the technical data in reference to TCDD was transmitted to the FAA on April 4.

In view of the alleged toxicity of TCDD, and based upon concern for the health of FAA employees who had worked, were currently working, and who would be assigned duties at the TRACON, the Administrator of the FAA directed the Deputy Federal Air Surgeon to investigate the matter and if necessary, assemble a group of

experts to provide the agency with guidance and recommendations. Upon assessment of the circumstances related to the finding of TCDD, it was determined that a group of experts should be assembled.

The experts who were contacted and agreed to assist the agency include the following (biographical sketches may be found in Appendix I):

B. Mason Hughes, Ph.D.
Gulf South Research Institute
New Orleans, Louisiana

Renate Kimbrough, M.D.
Center for Disease Control
Atlanta, Georgia

Walter Melvin, M.D., ~~M.D.~~Sc.
Colorado State University
Ft. Collins, Colorado
Professor of Environmental Health Sciences

Alvin Lee Young, Ph.D.
United States Air Force
Brooks AFB, ~~Texas~~
San Antonio, Texas
Environmental Sciences Consultant
USAF School of Aerospace Medicine

II. ACTION TAKEN

To assist the FAA in arriving at decisions regarding the health of employees at the TRACON, a series of questions were developed for submission to the consultant experts (see Appendix II). Background information consisting of a Draft Final Report of Environmental Assessment of the HRRC Plant, by Midwest Research Institute (February 1980), technical information on the solid waste recovery process used at the HRRC facility (Mechanical Engineering Magazine, December 1977), and miscellaneous news clippings and correspondence

were sent to the identified consultants for review. A meeting of the consultants was scheduled for April 25 at the FAA Regional Office in Jamaica, New York, to discuss the available data, view the HRRC plant and the TRACON facility, and to formulate guidance information and recommendations for the agency. Representatives from USEPA and the Occupational Health and Safety Administration (OSHA) were invited to this meeting.

The meeting of the consultant group (with the exception of Dr. Melvin) and USEPA and OSHA representatives convened on April 25 at the FAA's Eastern Regional Office in Jamaica, New York. Following a briefing by FAA personnel, a tour of the TRACON facility was conducted. Members of the FAA's advisory group also toured the HRRC plant. A meeting of the advisory group and USEPA and OSHA representatives at the TRACON following the tours provided an opportunity for exchange of views and information in respect to the finding of dioxins in the emissions from the HRRC plant.

III. ADVISORY GROUP FINDINGS AND RECOMMENDATIONS

Based upon a review of the February 1980 environmental assessment by Midwest Research Institute, the site visit to the HRRC plant, the TRACON facility, and discussions with representatives from USEPA and OSHA, it is recognized that dioxin is not the only class of chemicals that pose a potential health problem in emissions from the HRRC plant. The advisory group was tasked, however, only with the question of dioxin contamination. Findings and recommendations are, therefore, confined to that issue.

The ability of the advisory group to provide strong recommendations and guidance in respect to the potential adverse health effects of dioxin emissions from the HRRC plant is severely hampered by the lack of specific data. The data available to the advisory group as of April 25 consisted of values from only two stack emission samples (see Appendix III). The results of these sample analyses can not be used to estimate environmental levels or human exposure levels at the TRACON facility. Furthermore, the two values represent only total TCDD and provide no information on isomeric distribution. Although this finding is of value in characterizing the emissions of dioxin, lack of data on isomeric distribution results in an inability to draw firm conclusions about health effects of the HRRC plant emissions.

Chloracne has been shown to be essentially due to 2,3,7,8 TCDD, an isomer of dioxin. Chloracne is an eruption of blackheads, usually accompanied by small yellow cysts. Mild cases of chloracne usually clear within months and complete resolution of 80 percent of cases is likely within 3 years. Chloracne is considered a sign of potential systemic poisoning and an indication of exposure to TCDD or some other chloracnigen.

Other toxic effects in humans believed caused by TCDD have been reported [redacted] during industrial production of 2,4,5-trichlorophenol and ~~2,4,5-T exposure during accidents~~ at ~~[illegible]~~ ~~of~~ chlorophenolic compounds known ever reported or at ~~industrial accidents~~ involving the synthesis of ~~these compounds~~, or from

~~such facilities and~~ exposure to herbicides and other materials containing TCDD. These reported toxic effects include skin disorders such as porphyria cutanea tarda and hyperpigmentation and hirsutism. Internal disorders include liver damage and disorders of the cardiovascular, urinary, respiratory, and metabolic systems. Polyneuropathies and neurasthenia or depressive syndromes have also been reported.

Although adverse health effects following exposures as indicated above have been reported, no adverse health effects have thus far been reported in the scientific literature as a result of TCDD emissions from municipal incinerators. However, a list of references is attached (see Appendix IV) that shows that 2,3,7,8 - TCDD and other isomers and cogners of dioxin may be formed under certain reaction conditions where chlorine, dioxin precursors, and elevated temperatures are present. The finding ~~that~~ a variety of dioxins is present in emissions of municipal incinerators has been reported in Europe, Japan, Canada, and the United States. The critical 2,3,7,8-TCDD isomer has not been found in emissions from coal-fired power plants. In municipal incinerators, it is believed to comprise only a small fraction of the total TCDD present.

TCDD has been shown to degrade readily in the presence of sunlight. It is assumed that TCDD which has been volatilized is more likely to be degraded in the presence of ultraviolet light than if

associated with particulates such as fly ash. Because of these variables, it is not known how much TCDD from such sources as municipal incinerators may contribute to the contamination of the environment.

Furthermore, the general background level of TCDD in the environment has not been established, nor has a Threshold Limit Value (TLV) for human exposure been identified. TLVs represent conditions under which it is believed that nearly all persons may be repeatedly exposed without adverse effects.

The recommendations and observations of the advisory group are, therefore, severely limited by the absence of sound technical data in reference to the emissions from the HRRC plant, and good scientific evidence of the potential adverse health effects of exposure to dioxins emitted from municipal incinerators.

IV. RECOMMENDATIONS

The following recommendations are provided on the basis of presently available technical information concerning the HRRC plant and the TRACON facility and in response to the specific questions presented in Appendix II:

1. Dermatologic screening for chloracne of all employees who are working or who worked for more than a year in the TRACON facility should be accomplished promptly. This recommendation

is made because of the lack of adequate information concerning the presence or absence of TCDD at the TRACON facility either while the HRRC was functioning or now while it is not. Chloracne is considered a sensative indicator of TCDD exposure in humans. The need for additional medical examinations (general physical examination, liver function studies, hematological assessment, chest x-rays, electrocardiograms, etc.) should be determined on an individual basis and the presence or absence of a finding of chloracne.

2. Baseline medical examinations to include general physical examination, liver function studies, complete blood counts, prothrombin times, 2-hour post prandial blood sugars, chest x-rays, urinalyses, and resting electrocardiograms should be obtained in all employees newly assigned to the TRACON facility. These examinations are designed to establish a baseline on the medical status of employees who are assigned to the TRACON and should continue until the potential environmental problems have been resolved.

3. Additional environmental samples for determining the presence of dioxin and measuring isomeric distribution should be collected from the grounds of the HRRC plant, the surrounding community, and the TRACON facility. A protocol for collecting samples is contained in Appendix V and site selection for the

the TRACON grounds is identified in Appendix VI. Collection and analysis of samples should involve cooperative action with USEPA. By obtaining these samples, it is anticipated that an estimate of FAA employee exposure to toxic isomers of dioxin may be made.

4. Close monitoring of the HRRC plant for toxic emissions is necessary should it resume operation. A fully developed sampling protocol is necessary and should be provided through cooperative effort between NYSDEC and USEPA. This should include monitoring of fly ash and smoke stack emissions. Dioxin emissions are contingent upon the efficiency of the combustion process. Therefore, the operating conditions of the boilers should be recorded during the sampling to include boiler temperature, fuel flow, and electrostatic precipitation.

5. Since chemical analysis for TCDD is cumbersome and time consuming, consideration should be given to using screening tests by bioassay methods as a means of estimating the potential adverse health effects of the HRRC plant emissions.

V. SUMMARY

Because of lack of sound technical data, it is not possible to determine whether FAA employees who were working at the TRACON while the HRRC plant was in operation have been exposed to a significant health hazard. It is anticipated that through dermatologic screening, answers to this question may be provided.

As to whether it is hazardous for FAA employees to continue to work at the TRACON facility now while the HRRC plant is not functioning, ~~it is concluded by~~ the advisory group believes that no significant hazard exists that would preclude staffing the facility. It is recommended, however, that soil and TRACON air filter samples be obtained and analyzed promptly to unequivocally confirm this conclusion.

The advisability from an employee health perspective of staffing of the TRACON facility when the HRRC plant resumes operation is largely dependent upon the efficient functioning of the plant. It is the understanding of the advisory group that the plant is now undergoing equipment and technical modifications that will improve efficiency. If operating at appropriate combustion temperatures, it may be reasonably expected that harmful dioxin isomers will not be found in plant emissions. Whether employees should be permitted to continue to work at the TRACON facility when the HRRC plant resumes operation and before emission samples are analyzed cannot be determined by the advisory group. Health risks, under such circumstances, are unknown at this time.

Respectfully submitted by:

B. Mason Hughes, Ph.D.
Renate Kimbrough, M.D.
Alvin Young, Ph.D.
Waltern Melvin, M.D., M. Sc.

APPENDIX II

QUESTIONS

Based on presently available information concerning dioxin emissions from HRRC:

Question 1. Have FAA employees who were working at the TRACON while the HRRC was in operation been exposed to a significant health hazard?

Question 2. Is it hazardous for FAA employees to continue to work at the TRACON now, while the HRRC is not functioning?

Question 3. Should any special health studies be conducted on employees who continue to work at the facility, and if so, what should these studies include?

Question 4. Should sampling studies to measure possible environmental contamination from dioxin be conducted now, and if so, what studies are suggested.

Question 5. If the HRRC resumes operation, what health risk, if any, would be incurred by FAA employees who continue to work at the FAA TRACON?

Question 6. If the HRRC resumes operation and FAA employees continue to work at this TRACON, what special health studies, if any, should be conducted by the FAA?

Question 7. If the HRRC resumes operation, what sampling studies should be conducted to measure dioxin concentrations in emissions and dioxin contamination of the environment around this TRACON?

APPENDIX III

Wright State University

Dayton, Ohio 45431

DRAFT

NOT FOR RELEASE

January 11, 1980

Mr. J. B. Homolya
EPA Technical Center Annex
Mail Drop 46
Research Triangle Park
North Carolina 27711

Dear Mr. Homolya,

The purpose of this letter is to provide written confirmation of the analytical results verbally transmitted to you on January 3, 1980. Also described herein are the details of the analytical techniques employed to determine the concentration of tetrachlorodibenzo-p-dioxin (TCDD) in the two samples submitted to the Brehm Laboratory under EPA Order #D1935NAEX (December 17, 1979).

The two samples submitted by EPA were received in our laboratory on December 19, 1979. Sample #RTP-2 contained 3.5 mL of sample and sample #RTP-133 contained 0.5 mL of sample. We understand from our conversations with you that these samples are extracts of the contents of two traps from a stack gas sampling train which was used to sample effluents from a municipal incinerator burning waste-fuel. Since you had cautioned us to consume as little of the samples as possible for our analyses, only 100 microliters of each sample was utilized in accomplishing our analyses.

Each of the two extracts was spiked with $^{37}Cl_4$-2,3,7,8 tetrachlorodibenzo-p-dioxin ($^{37}Cl_4$-2,3,7,8-TCDD) and then the extracts were subjected to an extensive clean-up procedure, in order to remove organics (such as PCBs) which interfere with the quantitative analysis of TCDD. The details of the procedures employed to clean up the extracts which you provided and the details of the gas chromatographic-high resolution mass spectrometric technique employed to quantitatively determine TCDD are listed in the attached preprint. This preprint has been submitted for publication in "Chemosphere".

The data which was obtained for the EPA extracts is attached to this report. The high resolution mass spectral 4-Peak Monitoring results obtained in the GC-HRMS analysis of the two EPA extracts, a calibration standard and two blank injections are illustrated in Figures 1-5. As you can see in the Figures, each GC-HRMS analysis of a sample results in a Four-Peak Array, which comprises peaks at m/z 319.8966 and m/z 321.8936 (typical of native TCDD having the natural isotope distribution) as well as at m/z 325.8055 (an indicator of polychlorinated biphenyl) and at m/z 327.8846 (characteristic of the $^{37}Cl_4$-2,3,7,8-TCDD used as an internal standard). The intensities of each of the four ions is reflected by the area of each of the four peaks. The Four-Peak Array is actually the sum of approximately 500 step-scans

generated by using the Brehm Laboratory's AEI MS-30 Mass Spectrometer, modified to include a special ESA scan circuit designed at Wright State. The ion signals are acquired and summed using a Nicolet 1074 Signal Averaging Computer. The five hundred scans are acquired during a discrete time interval corresponding to the width (in seconds) of the base of the chromatographic peak for TCDD. As explained in the attached preprint, the GC-HRMS technique is not necessarily isomer specific and thus TCDD isomers other than 2,3,7,8-TCDD if present may contribute to the concentration of TCDD reported for the EPA samples. In view of the recent reports published by Dow Chemical Co. (1), and by Olie and Hutzinger (2), and Buser (3), it is highly probable that TCDD isomers other than the 2,3,7,8-TCDD isomer are present in the EPA samples, since these samples are the results of sampling the stack effluent from a refuse incinerator. In addition it is quite probable that other chlorinated dibenzo-p-dioxins such as the hexachlorodibenzo-p-dioxins, heptachlorodibenzo-p-dioxins, and octachlorodibenzo-p-dioxin are present in these samples. These so-called higher chlorinated dioxins if present do not interfere with the GC-HRMS determination of TCDD.

Table 1 lists the analytical results obtained for the EPA extracts. It can be seen in the table that the TCDD present in the sample was quantitated on the basis of the intensities of mass peaks at both m/z 319.8966 and m/z 321.8936. These two values for the quantity of TCDD were then averaged and are expressed in the table as "total TCDD present". In addition, this value for total TCDD was divided by the volume of the original sample to arrive at a concentration of TCDD present in each sample. Also listed in Table 1 are the minimum detectable concentrations for each sample (based upon the quantitative aspects of the clean-up procedure as well as the GC-HRMS measurement). Finally, the percent recovery of the $^{37}Cl_4$-2,3,7,8-TCDD internal standard added to each sample is also listed in the Table. Further details regarding the calibration techniques employed in these analyses are given in the attached preprint.

Regarding the isomer-specific analysis for TCDD, the Brehm Laboratory has developed the capability to perform quantitation of 2,3,7,8-TCDD in various samples, in the presence of eleven other isomers, and at the same time obtaining qualitative results for these eleven other isomers. In addition we have previously developed and applied GC-HRMS analytical techniques for the determination of hexa, hepta and octachlorodibenzo-p-dioxins in various types of samples. Presumably pentachlorodibenzo-p-dioxin could also be quantitated using the same or similar methodology, providing that the pentachlorodibenzo-p-dioxin calibration standards are available.

We would be happy to discuss these results further with you at anytime. Should you desire that our laboratory conduct additional studies of these extracts, which we strongly recommend, approximately 75% of each extract is still on hand.

We appreciate the opportunity to work with you on this most interesting

---

REFERENCES

1. Dow Chemical Co., "Trace Chemistries of Fire," Industrial Report, (1978).

2. K. Olie, P. L. Vermeulen, and O. Hutzinger, Chemosphere 6, 455 (1977).

3. H. R. Buser, H. R. Bosshardt, and C. Rappe, Chemosphere 7, 165 (1978).

problem and look forward to future interactions. Our invoice for these analyses has been forwarded to the EPA office designated in the purchase order.

Sincerely,

Michael L. Taylor

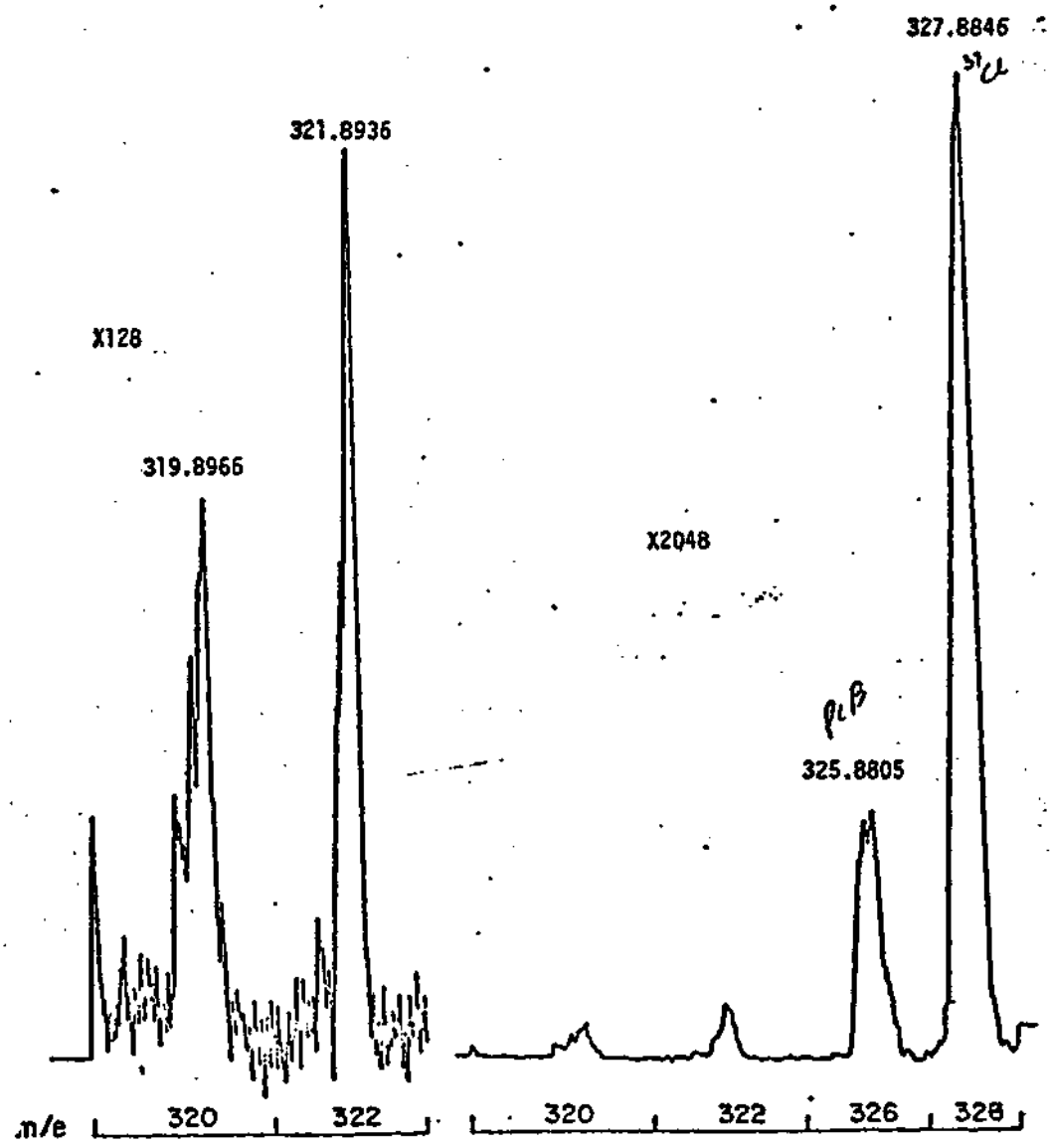
Michael L. Taylor, Ph.D.
Associate Professor of Pharmacology
and Associate Director, Brehm
Laboratory

Encl.
c.c.: Dr. Thomas O. Tiernan
MLT/ch

HIGH RESOLUTION GC/MS RESULTS OBTAINED BY WRIGHT STATE UNIVERSITY IN THE ANALYSIS OF TETRACHLORODIBENZO-p-DIOXIN (TCDD) IN RTP REFUSE INCINERATOR STACK SAMPLE EXTRACTS

	Native TCDD Detected Picograms in Total Extract			Native TCDD Detected PPB In Extract			Quantity of Extract Received	Minimum Detectable Quantity (pg)	% Recovery
	m/e 320	m/e 322	Average	m/e 320	m/e 322	Average			
P-2	1600	1270	1440	0.457	0.363	0.410	3.5 mL	100	78
P-133	1120	1340	1230	2.24	2.68	2.46	0.5 mL	100	93

Fig. 1. GC-HRMS Four-Peak Monitoring Results Obtained for A Standard Solution Containing 30 x 10^{-12} g Native TCDD and 1 x 10^{-9} g $^{37}Cl_4$TCDD.



APPENDIX IV

SELECTED LITERATURE

1. Chlorinated Dioxin Task Force. 1978. The trace chemistries of fire - A source of and routes for the entry of chlorinated dioxins into the environment. The Michigan Division, Dow Chemical USA, Midland, Michigan, 46 p.

2. Dobbs, A. J. and C. Grant. 1979. Photolysis of highly chlorinated dibenzo-p-dioxins by sunlight. Nature 278:163-165.

3. Eiceman, G. A., R. E. Clement, and F. W. Karsek. 1979. Analysis of fly ash from municipal incinerators for trace organic compunds. Anal. Chem. 51(14):2343-2350.

4. Jansson, B. and G. Sundstrom. 1978. Formation of polychlorinated dibenzo-p-dioxins during combustion of chlorophenol formulations. Sci. Total Environment (The Netherlands) 10:209-217.

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6. Kimbrough, R. D. 1974. The toxicity of polychlorinated polycyclic compounds and related chemicals. Crit. Rev. Toxicology. 2:445-498.

7. Langer, H. G., T. P. Brady, and P. R. Briggs. 1973. Formation of dibenzodioxins and other condensation products from chlorinated phenols and derivatives. Environmental Health Perspect. 5:3-7.

8. Plimmer, J. R. 1978. Photolysis of TCDD and trifluralin on silica and soil. Bull. Environmental Contamination Toxicology. 20:87-92.

9. Rappe, C. and H. R. Buser. 1979. Formation and degradation of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzo-furans (PCDFs) by thermal processes. Presentation to the Division of Pesticide Chemistry, American Chemical Society, Washington, DC, September 13, 1979, Washington, DC, Mimo. 21p.

10. Young, A. L., J. C. Calcagni, C. E. Thalken, and J. W. Tremblay. 1978. The toxicology, environmental fate, and human risk of herbicide orange and its associated TCDD. Technical Report OEHL-TR-78-92, USAF Occupational and Environmental Health Laboratory, Brooks AFB, San Antonio, Texas. 247p.

DRAFT

Report of the FAA

Dioxin Advisory Team

April 25, 1980

I. Introduction

Subsequent to the announcement by the Environmental Protection Agency (EPA), Region II, that tetrachlorodibenza dioxin (TCDD) was found in two components of an air emission sample, the Federal Aviation Administration (FAA) became concerned about the potential exposure of workers to TCDD in their TRACON Facility. This facility is located adjacent to the Hempstead Resources Recovery Corportation (HRRC) Plant in Garden City, New York.

A meeting was convened in New York on April 25. A list of the attendants at the meeting is appended (Appendix I). Doctors Renate Kimbrough, Alvin Young, and B. Mason Hughes served as special consultants to the FAA. These three consultants were asked to address the potential health problems resulting from possible dioxin exposure in employees of the TRACON facility.

A list of questions was also asked of the consultants (Appendix II).

II. Task

Following the review with an EPA report, which was submitted to the FAA on April 4, a site visit of the Hempstead HRRC Plant, the TRACON Facility, and discussions with representatives from EPA, it was recognized that dioxin is not the only class of chemicals posing a potential health problem as emissions from the HRRC facility.

Since the advisory team was tasked only to deal with the problem of dioxin contamination, this report is confined to that issue. The data available to the task force as of April 25 consisted of but two values, neither of which could be used to estimate environmental levels or human exposure levels at the TRACON Facility. These two values represented only total TCDD, but gave no information on isomeric distribution. Although this finding assists in characterizing the emissions of dioxin, it is insufficient to draw any conclusions about health effects.

III. Pertinent Literature

A list of references is attached (Appendix III) which shows that 2, 3, 7, 8 TCDD and other isomers and cogeners of dioxin may be formed under certain reaction conditions where chlorine, dioxin precursor and elevated temperatures are present. The finding that a variety of dioxin are present in emissions of municipal incinerators has been reported in Europe, Japan, Canada, and the United States. The 2, 3, 7, 8 TCDD isomer has not been found in emissions from coal-fired power plants. In municipal incinerators it comprises only a small fraction of the total TCDD present.

TCDD has been shown to degrade readily in the presence of sun light. It is assumed that TCDD, which has been volatilized is more likely to be degraded in the presence of ultraviolet light than if associated with particulates such as fly ash. Because of these variables, it is present by not knowing how much TCDD from

such sources as municipal incinerators contribute to the contamination of the environment. Nor has it been established what the general background level of TCDD in the environment is.

No health effects have thus far been reported in the literature as the result of TCDD emissions from municipal incinerators. All available information dealing with health effects due to exposure to TCDD come from studies of occupational or accidental exposure during manufacture or use of chlorinated phenols and their derivatives.

IV. Recommendations

The following recommendations are provided in response to the questions in Appendix II:

1. Because of the lack of adquate information on the presence or absence of TCDD in the TRACON facility and because of the long delay in obtaining such information by chemical analysis a screening of the skin of all employees that have worked for more than a year in the TRACON facility should be conducted by a dermatologist experienced in the appearance of chloracne. Chloracne is a sensitive indicator of TCDD exposure in humans. This screening should be conducted promptly.

2. Baseline medical examinations should be obtained on all employees newly assigned to the TRACON facility with appropriate clinical chemistry tests. This should continue until the present

potential environmental problems have been resolved.

3. Additional environmental samples from the grounds of the HRRC, the surrounding community, and within the TRACON facility should be collected and analyzed. The individual TCDD isomers must be identified. A cooperative study with the U.S. EPA is recommended. A map of proposed additional sampling sites at the TRACON facility is attatched (Appendix IV).

4. Close monitoring of the HRRC facility should it resume operation is essential. A fully developed sampling protocol is necessary. This should include monitoring of fly ash and smokestack emissions. The operating conditions of the boilers should be recorded during sampling including boiler temperature, fuel flow, and efficiency of the electrostatic precipitator.

5. Since chemical analysis for TCDD is cumbersome and time consuming, conducting screening tests by using bioassay methods should be considered.

APPENDIX I

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APPENDIX II

QUESTIONS AND ANSWERS

Based on presently available information concerning dioxin emissions from HRRC:

Question. Have FAA employees who were working at the TRACON while the HRRC was in operation been exposed to a significant health hazard?

Answer. We do not know because of insufficient monitoring data.

Question. Is it hazardous for FAA employees to continue to work at the TRACON now, while the HRRC is not functioning?

Answer. No.

Question. Should any special health studies be conducted on employees who continue to work at the facility, and if so, what should these studies include?

Answer. See recommendations.

Question. Should sampling studies to measure possible environmental contamination from dioxin be conducted now, and if so, what studies are suggested?

Answer: Yes, see recommendation 3.

Question. If the HRRC resumes operation, what health risk, if any, would be incurred by FAA employees who continue to work at the FAA TRACON?

Answer. If the incinerator operates under optimal conditions with maximum efficiency, hazard associated with its operation should be minimal.

Question. If the HRRC resumes operation and FAA employees continue to work at this TRACON, what special health studies, if any, should be conducted by the FAA?

Answer. Details are in recommendations 1 and 2.

Question. If the HRRC resumes operation, what sampling studies should be conducted to measure dioxin concentrations in emissions and dioxin contamination of the environment around this TRACON?

Answer. Details are in recommendations 4 and 5.

my [illegible] info

MAY 9 1980

Major General Murphy A. Chesney
Deputy Surgeon General
Bolling Air Force Base
Washington, DC 20332

Dear General Chesney:

This is in follow up to our telephone conversation of April 7 in which I requested the assistance of Major Alvin Young of Brooks Air Force Base in solving potential health problems for Federal Aviation Administration (FAA) employees at an air traffic control facility in New York.

As you will recall, the FAA became aware that dioxin had been found in samples of gases emitted from a resource recovery plant that is located adjacent to the agency's Terminal Radar Approach Control (TRACON) Facility at Hempstead, Long Island. Because of concern for the health of FAA employees located at this facility, Mr. Langhorne Bond, FAA Administrator, asked the Office of Aviation Medicine to obtain the assistance of recognized experts to advise the agency on the potential toxic effects of dioxin.

In researching issues related to dioxin toxicity, it quickly became apparent that Major Young's extensive background and expertise in dioxin problems would make him a desirable member of a group of experts that could advise the FAA. This conclusion prompted my phone call on April 7.

Major Young's assistance was arranged through Colonel George Lathrop of Brooks Air Force Base. In addition to reviewing technical information, Major Young participated in a meeting of a group of experts that convened at our regional office in New York on April 25. Doctor Jon Jordan, Deputy Federal Air Surgeon, presided at this meeting.

Doctor Jordan informs me that Major Young's assistance has proved to be invaluable. He has taken a very active interest in the problems confronting the FAA and has provided much of the technical expertise necessary to resolve the issues. His recommendations for FAA action have proved to be remarkably sound and workable. In short, Major Young's contributions to the success of our effort to define the health problems at the TRACON facility have been outstanding.

I cannot overemphasize the importance of the dioxin question to the FAA. The TRACON facility is an essential part of a new air traffic control system for the New York area. The facility itself is valued at more than 35 million dollars, and its potential contribution to air safety is immeasurable. Without a resolution of the health issues related to dioxin exposure, it is questionable as to whether the facility can be made fully operational.

Although the work of the group of experts, including Major Young, is not yet complete, I wanted to let you know that we deeply appreciate the position the Air Force has taken in making Major Young available to us. Major Young's contributions reflect favorably on us all.

Sincerely,

JOHN L. JORDAN, M.D.
DEPUTY FEDERAL AIR SURGEON

H. L. RIEGHARD, M.D.
Federal Air Surgeon, AAM-1

cc: Major Young

12 May 1980

Dr. Jon L. Jordan
Deputy Federal Air Surgeon (AAM-2)
Department of Transportation
Washington DC 20591

Dear Dr. Jordan

Attached please find a copy of a suggested protocol for sampling soils contaminated with tetrachlorodibenzodioxins. I have not heard from Ms. Halprin concerning the proposed soil sampling at the TRACON facility.

As noted during our telephone conversation of 8 May, with few minor corrections, the report of the FAA Dioxin Advisory Team is ready to be presented to the Administrator. I certainly enjoyed the opportunity to assist you in this matter and I am hopeful that my efforts have been of benefit to you and the FAA.

Sincerely

ALVIN L. YOUNG, Major, USAF, PhD
Consultant, Environmental Sciences

1 Atch
Soil Sampling Protocol

PROTOCOL: SAMPLING SOILS FOR TETRACHLORODIBENZODIOXINS*

Sampling protocols for tetrachlorodibenzodioxins (TCDD) have been described by Young et al (1, 2). These methods are predicated on the chemical nature of TCDD and on the methods involved in the contamination of the soil. TCDD is essentially water insoluble. When applied to soil as a liquid, e.g., as a contaminant of a liquid herbicide, it apparently binds tightly to soil particles. These particles can be moved by wind or water, with minimal loss of the TCDD. Thus sampling a site contaminated with aerially applied TCDD, either as a liquid or on particles, it is important that the soil be sampled carefully through a series of depth increments. Figure 1 is the recommended procedure. The removal of a soil increment of 1 x 5 x 10 cm will provide approximately 50 gms of soil. Although this is sufficient for an analysis, it is frequently recommended that two (2) locations be collected (not more than a few meters from each other) and the samples pooled by depth. When an area of approximately one hectare is to be sampled, at least 3 sets of samples should be collected so as to adequately represent the area. Separate analyses should be performed on these samples.

A second method of sampling the soils of an area thought to be contaminated with TCDD is to find the locations where particles of soil would accumulate. as a consequence of wind or water action. Sites that accumulate silt from areas in excess of one (1) hectare and have the silt collected in the out-fall of a pipe or drainage system are ideal. If a crude estimate can be made of the size of area drained and the amount of soil residue accumulated at an out-fall over a set period of time then an increment of that soil may permit an estimate of rate of contamination. Usually a 100 gram sample of soil is collected.

All soil samples collected for TCDD should be done using gloves, porcelin spatulas and amber glass jars with aluminum liners in the caps. The samples should be frozen as soon as convenient and retained frozen until prepared for analysis.

REFERENCES:

1. Young, A.L., C.E. Thalken and W.J. Cairney. 1979. Herbicide Orange site treatment and environmental monitoring. Air Force Technical Report OEHL-TR-79-169. USAF Occupational and Environmental Health Laboratory, Brooks AFB TX 78235. 36 p.

2. Young, A.L., C.E. Thalken and W. E. Ward. 1975. Studies on the ecological impact of repetitive aerial applications of herbicides on the ecosystem of Test Area C-52A, Eglin AFB, Florida. Air Force Technical Report AFATL-TR-75-142. Air Force Armament Laboratory, Eglin AFB FL 32542. 127 p.

*Prepared by A. L. Young, Epidemiology Division, USAF School of Aerospace Medicine, Brooks AFB TX 78235.

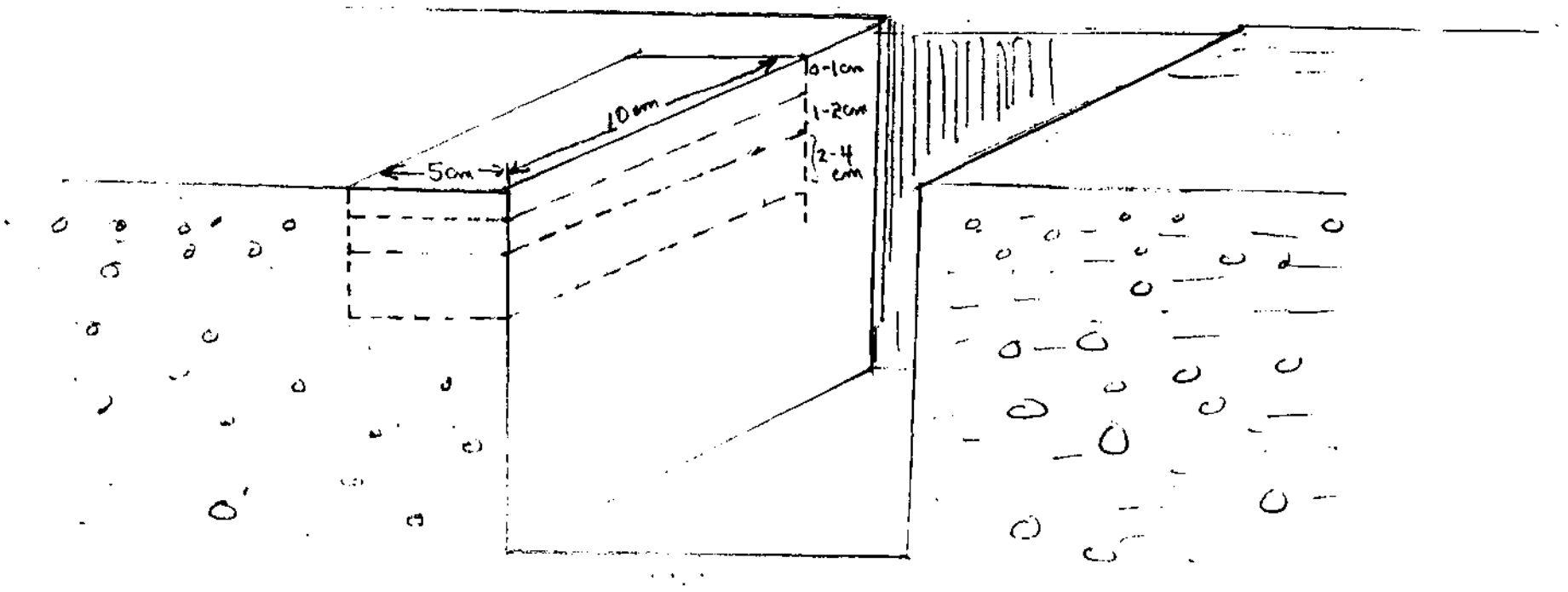

Figure 1. Ditch method of collecting soil increments for analysis of tetrachlorodibenzodioxins. Incremental samples are removed by undercutting the soil from the wall exposed within the ditch.

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DATE: May 28, 1980 WASHINGTON, D.C. 20591

IN REPLY REFER TO: AAM-1

SUBJECT: Report of the FAA Dioxin Advisory Group

FROM: Deputy Federal Air Surgeon, AAM-2

TO: Administrator

Enclosed for your information is the initial report of the FAA Dioxin Advisory Group. Also enclosed is a curriculum vitae for each member of the group.

As developed, additional data will be referred to the group for further recommendations. You will be advised of any new recommendations that are received.

JON L. JORDAN, M.D.

3 Enclosures

Summary

Purpose: To determine the potential adverse health effect of "dioxin"* at the FAA Terminal Radar Approach Control facility at Garden City, New York.

Discussion: "Dioxin," a potentially toxic compound, has been found in gaseous emissions of a waste-to-energy conversion plant in Garden City, New York. Proximity of this plant to the FAA's TRACON facility has raised questions concerning employee health.

To assist the FAA in resolving the employee health-related issues, an advisory group of experts on "dioxin" has been established. The group has reviewed all available technical information and viewed the concerned facilities.

Group Conclusions and Recommendations:

1. It is not possible to determine whether FAA employees who were working at the TRACON while the conversion plant was in operation have been exposed to a significant health hazard. Dermatologic screening may answer this question.

2. It is not believed that a health hazard exists for employees now working at the TRACON. This should be further confirmed, however, by conducting dermatologic screening of employees and obtaining soil and air filter samples for analysis for TCDD. Baseline medical examinations should be conducted on all employees newly assigned to the TRACON.

3. The advisability of staffing the TRACON when and if the conversion plant resumes operation is dependent upon the efficient functioning of the plant and the availability of information concerning TCDD emissions. Until the information becomes available, health risks are unknown.

Action Pending:

1. Dermatologic screening of employees at the TRACON has been completed. It is expected that the results of the examinations will be received in the near future.

2. Soil and filter samples for measurement of TCDD have been collected by the FAA and sent to a laboratory for analysis. Analysis is expected to take approximately three weeks.

*(tetrachlorodibenzodioxin (TCDD))

Report of the

FAA DIOXIN ADVISORY GROUP

May 22, 1980

I. INTRODUCTION

On Friday, March 21, 1980, Newsday, a Long Island newspaper, published a report that "dioxin" (later referred to as tetrachlorodibenzodioxin (TCDD)) had been found in emissions from a resources recovery (waste-to-energy conversion) plant in Garden City, New York. This information had impact on the Federal Aviation Administration (FAA) because the agency's new Terminal Radar Approach Control (TRACON) facility in Garden City is located adjacent to the recovery plant.

Although the FAA had had previous correspondence and contact with management of the recovery facility (Hempstead Resources Recovery Corporation (HRRC)), The New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) concerning adverse environmental effects produced by operation of the HRRC facility, the presence of TCDD in the emissions was unknown to the FAA prior to publication of the information in Newsday. The finding of TCDD was later confirmed to the FAA by USEPA and a copy of a report of environmental assessment prepared by the Midwest Research Institute (MRI), Kansas City, Missouri, containing the technical data in reference to TCDD was transmitted to the FAA on April 4, 1980. This report was prepared under a contract with USEPA in support of a research program to conduct environmental assessments of various types of waste-to-energy conversion systems.

Even though the HRRC facility was not operating when the finding of TCDD was reported, the Administrator of the FAA directed the Deputy Federal Air Surgeon to investigate the matter and, if necessary, assemble a

group of experts to provide the agency with guidance and recommendations. This decision was made in view of the alleged toxicity of TCDD, and was based upon concern for the health of FAA employees who had worked, were currently working, and who would be assigned duties at the TRACON. Upon assessment of the circumstances related to the finding of TCDD, it was determined that a group of experts should be assembled.

The experts who were contacted and agreed to assist the agency include the following:

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Alvin Lee Young, Ph.D.
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USAF School of Aerospace Medicine
Brooks AFB, San Antonio, Texas

II. ACTION TAKEN

To assist the FAA in arriving at health-related decisions concerning employees at the TRACON, a series of questions was developed for submission to the consultant experts (see Appendix I). Background information consisting of a Draft Final Report of Environmental Assessment of the

HRRC Plant, by MRI (February 1980), technical information on the solid waste recovery process used at the HRRC facility (Mechanical Engineering Magazine, December 1977), and miscellaneous news clippings and correspondence were sent to the consultants for review. A meeting of the consultants was scheduled for April 25 at the FAA Regional Office in Jamaica, New York, to discuss the available data, view the HRRC plant and the TRACON facility, and, if possible, to arrive at conclusions and make recommendations to the FAA. Representatives from USEPA and the Occupational Health and Safety Administration (OSHA) were invited to this meeting.

The meeting of the consultant group (with the exception of Dr. Melvin) and USEPA and OSHA representatives convened on April 25 at the FAA's Eastern Regional Office in Jamaica, New York. Following a briefing by FAA personnel, a tour of the TRACON facility was conducted. Members of the FAA's advisory group also toured the HRRC plant. A meeting of the advisory group and USEPA and OSHA representatives at the TRACON following the tours provided an opportunity for exchange of views and information in respect to the finding of TCDD in the emissions from the HRRC plant.

III. ANALYSIS OF FACTS

Based upon a review of the February 1980 environmental assessment by MRI, the site visit to the HRRC plant, the TRACON facility, and discussions with representatives from USEPA and OSHA, it is recognized that TCDD is not the only compound found in the emissions from the HRRC plant that may be of concern. The advisory group was tasked, however, only

with the question of TCDD contamination. Findings and recommendations are, therefore, confined to that issue.

The ability of the advisory group to provide strong recommendations and guidance in respect to the potential adverse health effects of TCDD emissions from the HRRC plant is severely hampered by the lack of specific data. The TCDD data available to the advisory group as of April 25, 1980, consisted of values from only two stack emission samples (these values were identified at the Brehm Laboratory, Wright State University - see Appendix II). The results of these sample analyses cannot be used to estimate environmental levels or human exposure levels at the TRACON facility. Furthermore, the two values represent only total TCDD and provide no information on isomeric distribution. Knowledge of the isomeric distribution is critical in assessing potential hazards of TCDD exposure. Although this finding is of value in characterizing the emissions of TCDD, lack of data on isomeric distribution results in an inability to draw firm conclusions about health effects of the HRRC plant emissions.

In regard to toxic effects of TCDD, chloracne, a skin condition characterized by an eruption of comedones usually accompanied by skin-colored cysts, has been shown to be usually due to the 2,3,7,8-TCDD isomer. Mild cases of chloracne usually clear within months and complete resolution of 80 percent of cases is likely within 3 years. Chloracne may occur because of direct contact of the skin with 2,3,7,8-TCDD or may be an expression of potential systemic poisoning and an indication of exposure to TCDD or some other chloracnegenic agent.

the environment. Furthermore, the general background level of TCDD in the environment has not been established, nor has a safe level, if any, for human exposure been defined.

The recommendations and observations of the advisory group are, therefore, severely limited by the absence of sound technical data in reference to the emissions from the HRRC plant, and good scientific evidence of the potential adverse health effects of exposure to TCDD emitted from municipal incinerators.

IV. RECOMMENDATIONS

The following recommendations are provided on the basis of presently available technical information concerning the HRRC plant and the TRACON facility and in response to the specific questions presented in Appendix I:

1. Dermatologic screening for chloracne of all employees who are working or who worked for more than one year in the TRACON facility should be accomplished promptly. This recommendation is made in view of the lack of adequate information concerning the presence or absence of TCDD at the TRACON facility either when the HRRC was functioning or now, while it is not. Chloracne is considered a sensitive indicator of TCDD exposure in humans. The need for immediately conducting additional medical examinations (general physical examination, liver function studies, urinalysis, uroporphyrin excretion, complete blood count, prothrombin time, fasting serum triglycerides, cholesterol and high density lipoprotein levels, 2-hour

post prandial blood sugar, etc.) will be established following review of the results obtained in the dermatological examination.

2. Baseline medical examinations to include general physcial examination (with special reference to the skin), liver function studies, urinalysis, uroporphyrin excretion, complete blood count, prothrombin time, fasting serum triglyceride, cholesterol and high density lipoprotein levels, 2-hour post prandial blood sugar, etc., should be obtained in all employees newly assigned to the TRACON facility. These examinations are designed to establish a baseline on the medical status of employees who are assigned to the TRACON and should continue until the potential environmental problems have been resolved.

3. Additional environmental samples for determining the presence of TCDD and measuring the isomeric distribution should be collected from the grounds of the HRRC plant, the surrounding community, and the TRACON facility. A protocol for collecting samples is contained in Appendix IV and site selection (as indicated by a circled "X") for the TRACON grounds is identified in Appendix V. Collection and analysis of samples should involve cooperative action with USEPA. By obtaining these samples, it is anticipated that an estimate of FAA employee exposure to toxic isomers of TCDD may be made.

4. Close monitoring of the HRRC plant for toxic emissions is mandatory, should it resume operation. A fully developed sampling protocol is

necessary and should be provided through cooperative effort between NYSDEC and USEPA. This should include monitoring of fly ash and smoke stack emissions. TCDD emissions are contingent upon the efficiency of the combustion process. Therefore, the operating conditions of the boilers should be recorded during the sampling to include boiler temperature, fuel flow, and electrostatic precipitation.

5. Since chemical analysis for TCDD is cumbersome and time consuming, consideration should be given to using screening tests by bioassay methods as a means of estimating the potential adverse health effects of the HRRC plant emissions.

V. SUMMARY

Because of lack of sound technical data, it is not possible to determine whether FAA employees who were working at the TRACON while the HRRC plant was in operation have been exposed to a significant health hazard. It is anticipated that through dermatologic screening, answers to this question may be provided.

As to whether it is hazardous for FAA employees to continue to work at the TRACON facility now, while the HRRC plant is not functioning, the advisory group believes that no hazard exists that would prohibit staffing of the facility. It is recommended, however, that soil and TRACON air filter samples be obtained and analyzed promptly to unequivocally confirm this conclusion.

The advisability from an employee health perspective of staffing the TRACON facility when the HRRC plant resumes operation is largely dependent upon the efficient functioning of the plant. It is the understanding of the advisory group that the plant is now undergoing equipment and technical modifications that will improve overall and especially combustion efficiency. If operating at appropriate combustion temperatures, it may be reasonably expected that harmful TCDD isomers will not be found in plant emissions. Whether employees should be permitted to continue to work at the TRACON facility when the HRRC plant resumes operation and before emission samples are analyzed cannot be determined by the advisory group. Health risks, under such circumstances, are unknown at this time.

Respectfully submitted in behalf of:

B. Mason Hughes, Ph.D.
Renate Kimbrough, M.D.
Alvin Young, Ph.D.
Walter Melvin, M.D., Sc.D.

by:

Jon L. Jordan, M.D.
Deputy Federal Air Surgeon, AAM-2
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

APPENDIX I

QUESTIONS

Based on presently available information concerning TCDD emissions from HRRC:

Question 1. Have FAA employees who were working at the TRACON while the HRRC was in operation been exposed to a significant health hazard?

Question 2. Is it hazardous for FAA employees to continue to work at the TRACON now, while the HRRC is not functioning?

Question 3. Should any special health studies be conducted on employees who continue to work at the facility, and if so, what should these studies include?

Question 4. Should sampling studies to measure possible environmental contamination from TCDD be conducted now, and if so, what studies are suggested?

Question 5. If the HRRC resumes operation, what health risk, if any, would be incurred by FAA employees who continue to work at the FAA TRACON?

Question 6. If the HRRC resumes operation and FAA employees continue to work at this TRACON, what special health studies, if any, should be conducted by the FAA?

Question 7. If the HRRC resumes operation, what sampling studies should be conducted to measure TCDD concentrations in emissions and TCDD contamination of the environment around the TRACON?

APPENDIX II

Wright State University

Dayton, Ohio 45431

DRAFT

NOT FOR RELEASE

January 11, 1980

Mr. J. B. Homolya
EPA Technical Center Annex
Mail Drop 46
Research Triangle Park
North Carolina 27711

Dear Mr. Homolya,

The purpose of this letter is to provide written confirmation of the analytical results verbally transmitted to you on January 3, 1980. Also described herein are the details of the analytical techniques employed to determine the concentration of tetrachlorodibenzo-p-dioxin (TCDD) in the two samples submitted to the Brehm Laboratory under EPA Order #D1935NAEX (December 17, 1979).

The two samples submitted by EPA were received in our laboratory on December 19, 1979. Sample #RTP-2 contained 3.5 mL of sample and sample #RTP-133 contained 0.5 mL of sample. We understand from our conversations with you that these samples are extracts of the contents of two traps from a stack gas sampling train which was used to sample effluents from a municipal incinerator burning waste-fuel. Since you had cautioned us to consume as little of the samples as possible for our analyses, only 100 microliters of each sample was utilized in accomplishing our analyses.

Each of the two extracts was spiked with $^{37}Cl_4$-2,3,7,8 tetrachlorodibenzo-p-dioxin ($^{37}Cl_4$-2,3,7,8-TCDD) and then the extracts were subjected to an extensive clean-up procedure, in order to remove organics (such as PCBs) which interfere with the quantitative analysis of TCDD. The details of the procedures employed to clean up the extracts which you provided and the details of the gas chromatographic-high resolution mass spectrometric technique employed to quantitatively determine TCDD are listed in the attached preprint. This preprint has been submitted for publication in "Chemosphere".

The data which was obtained for the EPA extracts is attached to this report. The high resolution mass spectral 4-Peak Monitoring results obtained in the GC-HRMS analysis of the two EPA extracts, a calibration standard and two blank injections are illustrated in Figures 1-5. As you can see in the Figures, each GC-HRMS analysis of a sample results in a Four-Peak Array, which comprises peaks at m/z 319.8966 and m/z 321.8936 (typical of native TCDD having the natural isotope distribution) as well as at m/z 325.8055 (an indicator of polychlorinated biphenyl) and at m/z 327.8846 (characteristic of the $^{37}Cl_4$-2,3,7,8-TCDD used as an internal standard). The intensities of each of the four ions is reflected by the area of each of the four peaks. The Four-Peak Array is actually the sum of approximately 500 step-scans

generated by using the Brehm Laboratory's AEI MS-30 Mass Spectrometer, modified to include a special ESA scan circuit designed at Wright State. The ion signals are acquired and summed using a Nicolet 1074 Signal Averaging Computer. The five hundred scans are acquired during a discrete time interval corresponding to the width (in seconds) of the base of the chromatographic peak for TCDD. As explained in the attached preprint, the GC-HRMS technique is not necessarily isomer specific and thus TCDD isomers other than 2,3,7,8-TCDD if present may contribute to the concentration of TCDD reported for the EPA samples. In view of the recent reports published by Dow Chemical Co. (1), and by Olie and Hutzinger (2), and Buser (3), it is highly probable that TCDD isomers other than the 2,3,7,8-TCDD isomer are present in the EPA samples, since these samples are the results of sampling the stack effluent from a refuse incinerator. In addition it is quite probable that other chlorinated dibenzo-p-dioxins such as the hexachlorodibenzo-p-dioxins, heptachlorodibenzo-p-dioxins, and octachlorodibenzo-p-dioxin are present in these samples. These so-called higher chlorinated dioxins if present do not interfere with the GC-HRMS determination of TCDD.

Table 1 lists the analytical results obtained for the EPA extracts. It can be seen in the table that the TCDD present in the sample was quantitated on the basis of the intensities of mass peaks at both m/z 319.8966 and m/z 321.8936. These two values for the quantity of TCDD were then averaged and are expressed in the table as "total TCDD present". In addition, this value for total TCDD was divided by the volume of the original sample to arrive at a concentration of TCDD present in each sample. Also listed in Table 1 are the minimum detectable concentrations for each sample (based upon the quantitative aspects of the clean-up procedure as well as the GC-HRMS measurement). Finally, the percent recovery of the $^{37}Cl_4$-2,3,7,8-TCDD internal standard added to each sample is also listed in the Table. Further details regarding the calibration techniques employed in these analyses are given in the attached preprint.

Regarding the isomer-specific analysis for TCDD, the Brehm Laboratory has developed the capability to perform quantitation of 2,3,7,8-TCDD in various samples, in the presence of eleven other isomers, and at the same time obtaining qualitative results for these eleven other isomers. In addition we have previously developed and applied GC-HRMS analytical techniques for the determination of hexa, hepta and octachlorodibenzo-p-dioxins in various types of samples. Presumably pentachlorodibenzo-p-dioxin could also be quantitated using the same or similar methodology, providing that the pentachlorodibenzo-p-dioxin calibration standards are available.

We would be happy to discuss these results further with you at anytime. Should you desire that our laboratory conduct additional studies of these extracts, which we strongly recommend, approximately 75% of each extract is still on hand.

We appreciate the opportunity to work with you on this most interesting

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REFERENCES

1. Dow Chemical Co., "Trace Chemistries of Fire," Industrial Report, (1978).
2. K. Olie, P. L. Vermeulen, and O. Hutzinger, Chemosphere 6, 455 (1977).
3. H. R. Buser, H. R. Bosshardt, and C. Rappe, Chemosphere 7, 165 (1978).

problem and look forward to future interactions. Our invoice for these analyses has been forwarded to the EPA office designated in the purchase order.

Sincerely,

Michael L. Taylor

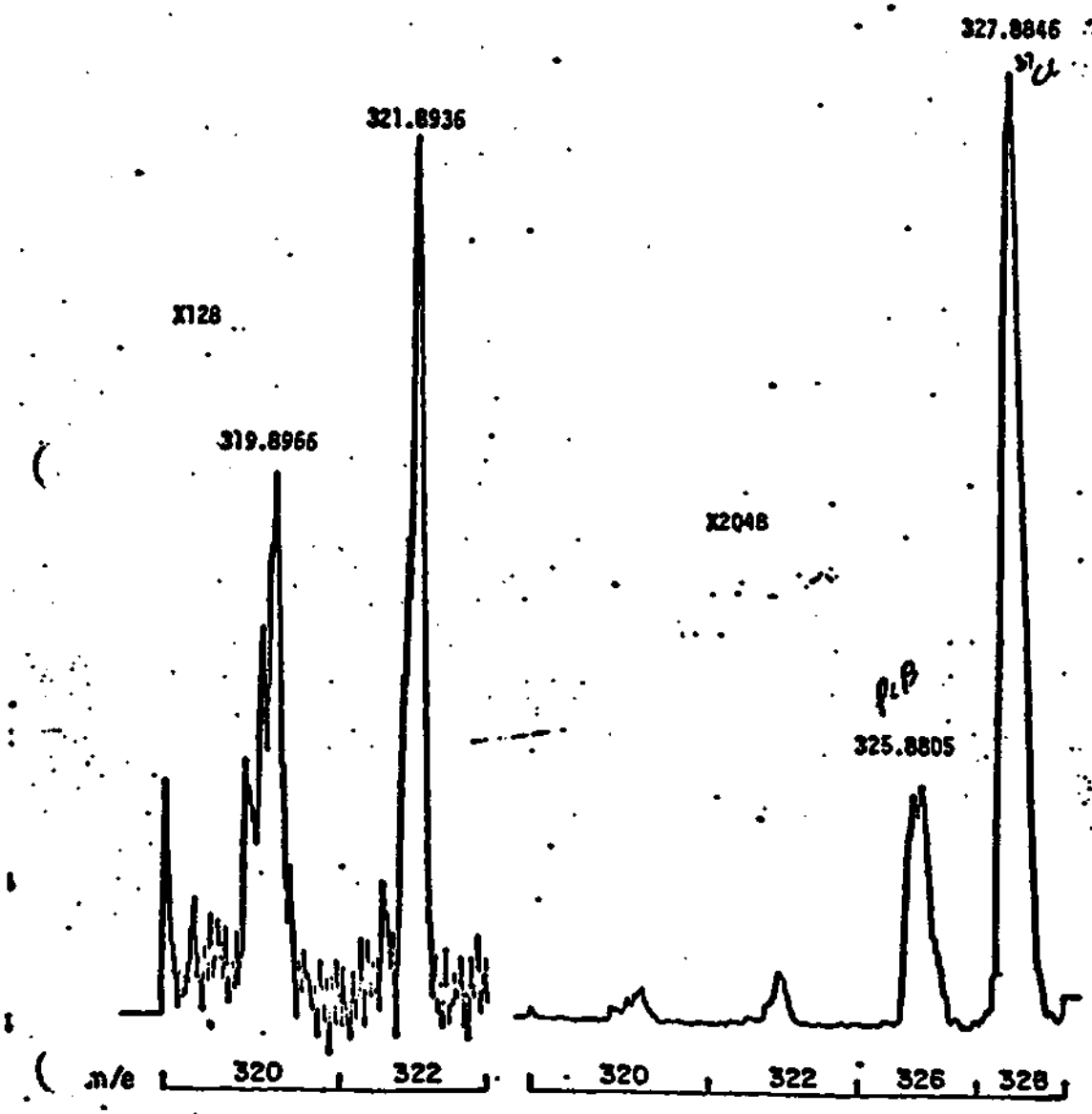
Michael L. Taylor, Ph.D.
Associate Professor of Pharmacology
and Associate Director, Brehm
Laboratory

Encl.
c.c.: Dr. Thomas O. Tiernan
MLT/ch

HIGH RESOLUTION GC/MS RESULTS OBTAINED BY WRIGHT STATE UNIVERSITY IN THE ANALYSIS OF TETRACHLORODIBENZO-p-DIOXIN (TCDD) IN RTP REFUSE INCINERATOR STACK SAMPLE EXTRACTS

	Native TCDD Detected Picograms in Total Extract			Native TCDD Detected PPB In Extract			Quantity of Extract Received	Minimum Detectable Quantity (pg)	% Recovery
	m/e 320	m/e 322	Average	m/e 320	m/e 322	Average			
P-2	1600	1270	1440	0.457	0.363	0.410	3.5 mL	100	78
P-133	1120	1340	1230	2.24	2.68	2.46	0.5 mL	100	93

Fig. 1. GC-HRMS Four-Peak Monitoring Results Obtained for A Standard Solution Containing 30×10^{-12} g Native TCDD and 1×10^{-9} g $^{37}Cl_4$TCDD.



APPENDIX III

SELECTED LITERATURE

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3. Eichman, G. A., R. E. Clement, and F. W. Karsek. 1979. Analysis of fly ash from municipal incinerators for trace organic compounds. Anal. Chem. 51(14):2343-2350.

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5. Kimble, B. J. and M. L. Gross. 1980. Tetrachlorodibenzo-p-dioxin quantitation in stack - collected fly ash. Science 207:59-61.

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7. Langer, H. G., T. P. Brady, and P. R. Briggs. 1973. Formation of dibenzodioxins and other condensation products from chlorinated phenols and derivatives. Environmental Health Perspect. 5:3-7.

8. Plimmer, J. R. 1978. Photolysis of TCDD and trifluralin on silica and soil. Bull. Enviornmental Contamination Toxicology. 20:87-92.

9. Rappe, C. and H. R. Buser. 1979. Formation and degradation of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzo-furans (PCDFs) by thermal processes. Presentation to the Division of Pesticide Chemistry, American Chemical Society, Washington, D.C., September 13, 1979, Washington, D.C., Mim. 21p.

10. Young, A. L., J. C. Calcagni, C. E. Thalken, and J. W. Tremblay. 1978. The toxicology, environmental fate, and human risk of herbicide orange and its associated TCDD. Technical Report OEHL-TR-78-92, USAF Occupational and Environmental Health Laboratory, Brooks AFB, San Antonio, Texas. 247p.

APPENDIX IV

PROTOCOL: SAMPLING SOILS FOR TETRACHLORODIBENZO DIOXINS*

Sampling protocols for tetrachlorodibenzodioxins (TCDD) have been described by Young et al (1, 2). These methods are predicated on the chemical nature of TCDD and on the methods involved in the contamination of the soil. TCDD is essentially water insoluble. When applied to soil as a liquid, e.g., as a contaminant of a liquid herbicide, it apparently binds tightly to soil particles. These particles can be moved by wind or water, with minimal loss of the TCDD. Thus sampling a site contaminated with aerially applied TCDD, either as a liquid or on particles, it is important that the soil be sampled carefully through a series of depth increments. Figure 1 is the recommended procedure. The removal of a soil increment of 1 x 5 x 10 cm will provide approximately 50 gms of soil. Although this is sufficient for an analysis, it is frequently recommended that two (2) locations be collected (not more than a few meters from each other) and the samples pooled by depth. When an area of approximately one hectare is to be sampled, at least 3 sets of samples should be collected so as to adequately represent the area. Separate analyses should be performed on these samples.

A second method of sampling the soils of an area thought to be contaminated with TCDD is to find the locations where particles of soil would accumulate. as a consequence of wind or water action. Sites that accumulate silt from areas in excess of one (1) hectare and have the silt collected in the out-fall of a pipe or drainage system are ideal. If a crude estimate can be made of the size of area drained and the amount of soil residue accumulated at an out-fall over a set period of time then an increment of that soil may permit an estimate of rate of contamination. Usually a 100 gram sample of soil is collected.

All soil samples collected for TCDD should be done using gloves, porcelin spatulas and amber glass jars with aluminum liners in the caps. The samples should be frozen as soon as convenient and retained frozen until prepared for analysis.

REFERENCES:

1. Young, A.L., C.E. Thalken and W.J. Cairney. 1979. Herbicide Orange site treatment and environmental monitoring. Air Force Technical Report OEHL-TR-79-169. USAF Occupational and Environmental Health Laboratory, Brooks AFB TX 78235. 36 p.

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*Prepared by A. L. Young, Epidemiology Division, USAF School of Aerospace Medicine, Brooks AFB TX 78235.

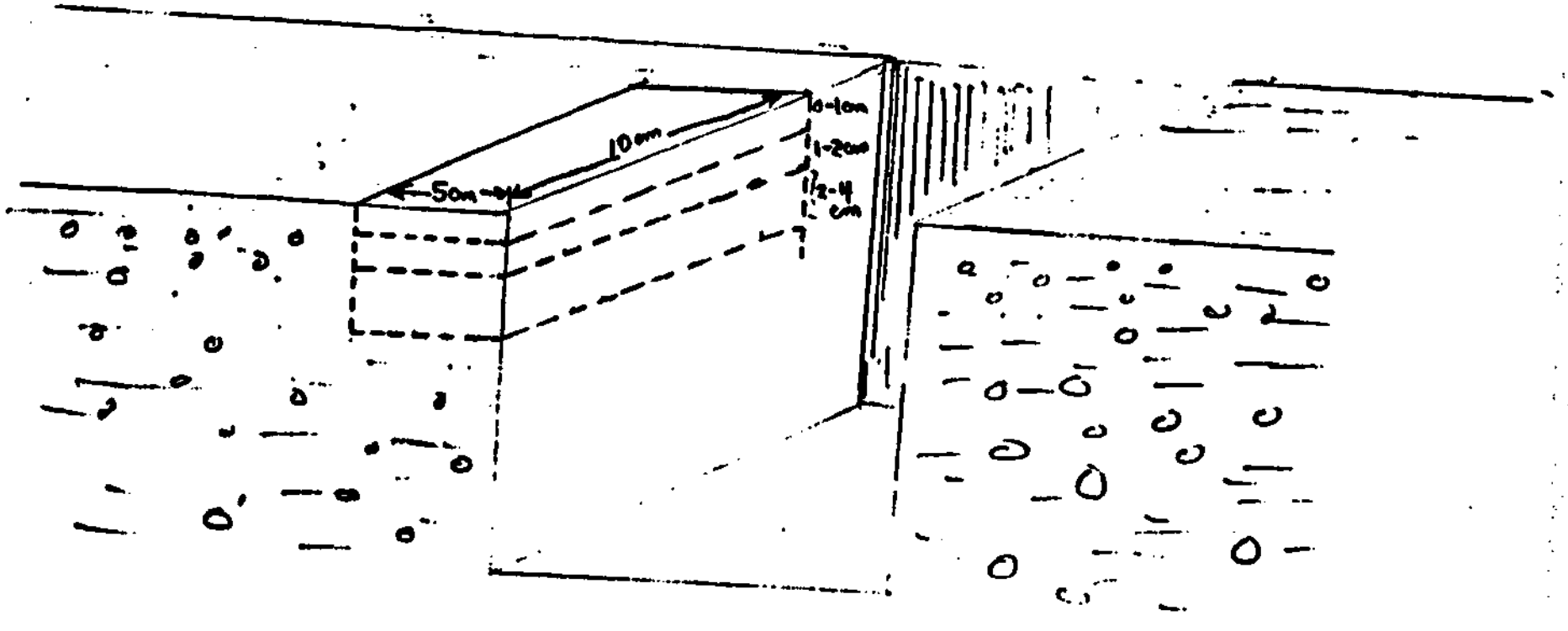

Figure 1. Ditch method of collecting soil increments for analysis of tetrachlorodibenzodioxins. Incremental samples are removed by undercutting the soil from the wall exposed within the ditch.

APPENDIX A
STEWART
AVENUE
VICINITY MAP

Wright State University

Dayton, Ohio 45431

DRAFT

NOT FOR RELEASE

January 11, 1980

Mr. J. B. Homolya
EPA Technical Center Annex
Mail Drop 46
Research Triangle Park
North Carolina 27711

Dear Mr. Homolya,

The purpose of this letter is to provide written confirmation of the analytical results verbally transmitted to you on January 3, 1980. Also described herein are the details of the analytical techniques employed to determine the concentration of tetrachlorodibenzo-p-dioxin (TCDD) in the two samples submitted to the Brehm Laboratory under EPA Order #D1935NAEX (December 17, 1979).

The two samples submitted by EPA were received in our laboratory on December 19, 1979. Sample #RTP-2 contained 3.5 mL of sample and sample #RTP-133 contained 0.5 mL of sample. We understand from our conversations with you that these samples are extracts of the contents of two traps from a stack gas sampling train which was used to sample effluents from a municipal incinerator burning waste-fuel. Since you had cautioned us to consume as little of the samples as possible for our analyses, only 100 microliters of each sample was utilized in accomplishing our analyses.

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The data which was obtained for the EPA extracts is attached to this report. The high resolution mass spectral 4-Peak Monitoring results obtained in the GC-HRMS analysis of the two EPA extracts, a calibration standard and two blank injections are illustrated in Figures 1-5. As you can see in the Figures, each GC-HRMS analysis of a sample results in a Four-Peak Array, which comprises peaks at m/z 319.8966 and m/z 321.8936 (typical of native TCDD having the natural isotope distribution) as well as at m/z 325.8055 (an indicator of polychlorinated biphenyl) and at m/z 327.8846 (characteristic of the $^{37}Cl_4$-2,3,7,8-TCDD used as an internal standard). The intensities of each of the four ions is reflected by the area of each of the four peaks. The Four-Peak Array is actually the sum of approximately 500 step-scans

generated by using the Brehm Laboratory's AEI MS-30 Mass Spectrometer, modified to include a special ESA scan circuit designed at Wright State. The ion signals are acquired and summed using a Nicolet 1074 Signal Averaging Computer. The five hundred scans are acquired during a discrete time interval corresponding to the width (in seconds) of the base of the chromatographic peak for TCDD. As explained in the attached preprint, the GC-HRMS technique is not necessarily isomer specific and thus TCDD isomers other than 2,3,7,8-TCDD if present may contribute to the concentration of TCDD reported for the EPA samples. In view of the recent reports published by Dow Chemical Co. (1), and by Olie and Hutzinger (2), and Buser (3), it is highly probable that TCDD isomers other than the 2,3,7,8-TCDD isomer are present in the EPA samples, since these samples are the results of sampling the stack effluent from a refuse incinerator. In addition it is quite probable that other chlorinated dibenzo-p-dioxins such as the hexachlorodibenzo-p-dioxins, heptachlorodibenzo-p-dioxins, and octachlorodibenzo-p-dioxin are present in these samples. These so-called higher chlorinated dioxins if present do not interfere with the GC-HRMS determination of TCDD.

Table 1 lists the analytical results obtained for the EPA extracts. It can be seen in the table that the TCDD present in the sample was quantitated on the basis of the intensities of mass peaks at both m/z 319.8966 and m/z 321.8936. These two values for the quantity of TCDD were then averaged and are expressed in the table as "total TCDD present". In addition, this value for total TCDD was divided by the volume of the original sample to arrive at a concentration of TCDD present in each sample. Also listed in Table 1 are the minimum detectable concentrations for each sample (based upon the quantitative aspects of the clean-up procedure as well as the GC-HRMS measurement). Finally, the percent recovery of the $^{37}Cl_4$-2,3,7,8-TCDD internal standard added to each sample is also listed in the Table. Further details regarding the calibration techniques employed in these analyses are given in the attached preprint.

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We would be happy to discuss these results further with you at anytime. Should you desire that our laboratory conduct additional studies of these extracts, which we strongly recommend, approximately 75% of each extract is still on hand.

We appreciate the opportunity to work with you on this most interesting

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REFERENCES

1. Dow Chemical Co., "Trace Chemistries of Fire," Industrial Report, (1978).

2. K. Olie, P. L. Vermeulen, and O. Hutzinger, Chemosphere 6, 455 (1977).

3. H. R. Buser, H. R. Bosshardt, and C. Rappe, Chemosphere 7, 165 (1978).

problem and look forward to future interactions. Our invoice for these analyses has been forwarded to the EPA office designated in the purchase order.

Sincerely,

Michael L. Taylor

Michael L. Taylor, Ph.D.
Associate Professor of Pharmacology
and Associate Director, Brehm
Laboratory

Encl.
c.c.: Dr. Thomas O. Tiernan
MLT/ch

HIGH RESOLUTION GC/MS RESULTS OBTAINED BY WRIGHT STATE UNIVERSITY IN THE ANALYSIS OF TETRACHLORODIBENZO-p-DIOXIN (TCDD) IN RTP REFUSE INCINERATOR STACK SAMPLE EXTRACTS

	Native TCDD Detected Picograms in Total Extract			Native TCDD Detected PPB In Extract			Quantity of Extract Received	Minimum Detectable Quantity (pg)	% Recovery
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P-2	1600	1270	1440	0.457	0.363	0.410	3.5 mL	100	78
P-133	1120	1340	1230	2.24	2.68	2.46	0.5 mL	100	93
			2.67			287			

Work by Raffe

13,68 TCDD
1,3,7,9 TDDD } ~ 2 ppb

2.67
287
4 | 554 = 1.4 ppb
4
15
12
34

Standard Solution Containing 30 x 10^{-12} g Native TCDD

and 1 x 10^{-9} g $^{37}Cl_4$ TCDD.

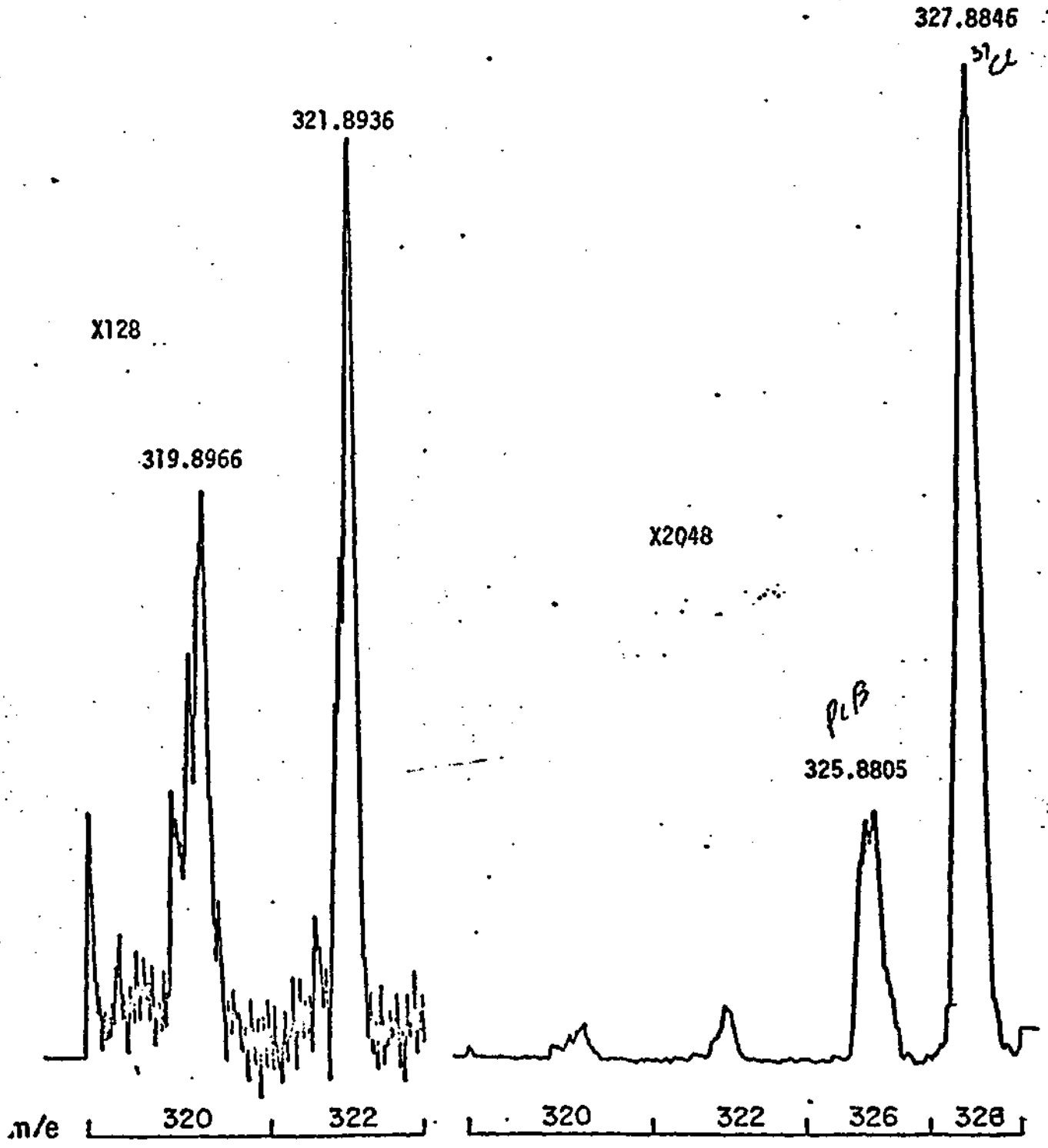
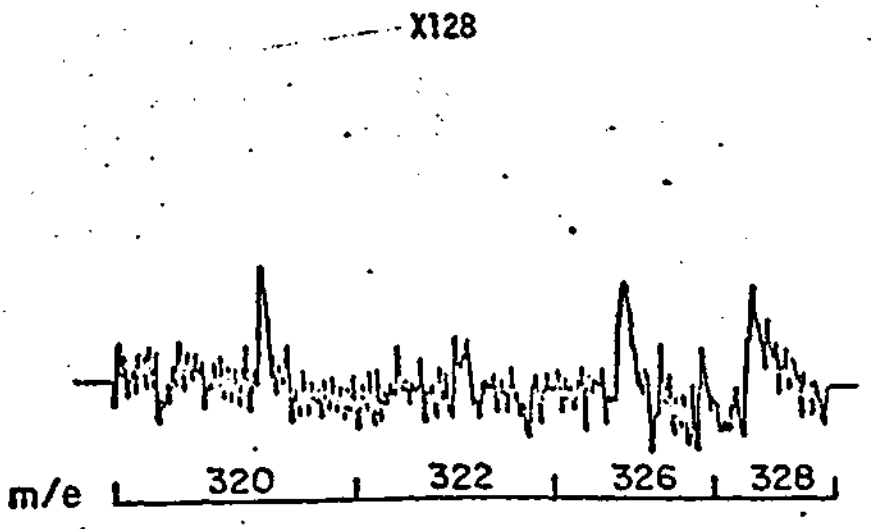


Fig. 2. GC-HRMS Four-Peak Monitoring Results Obtained for a Solvent Blank Analyzed Immediately Following Analysis of a Standard.



for RTP-133.

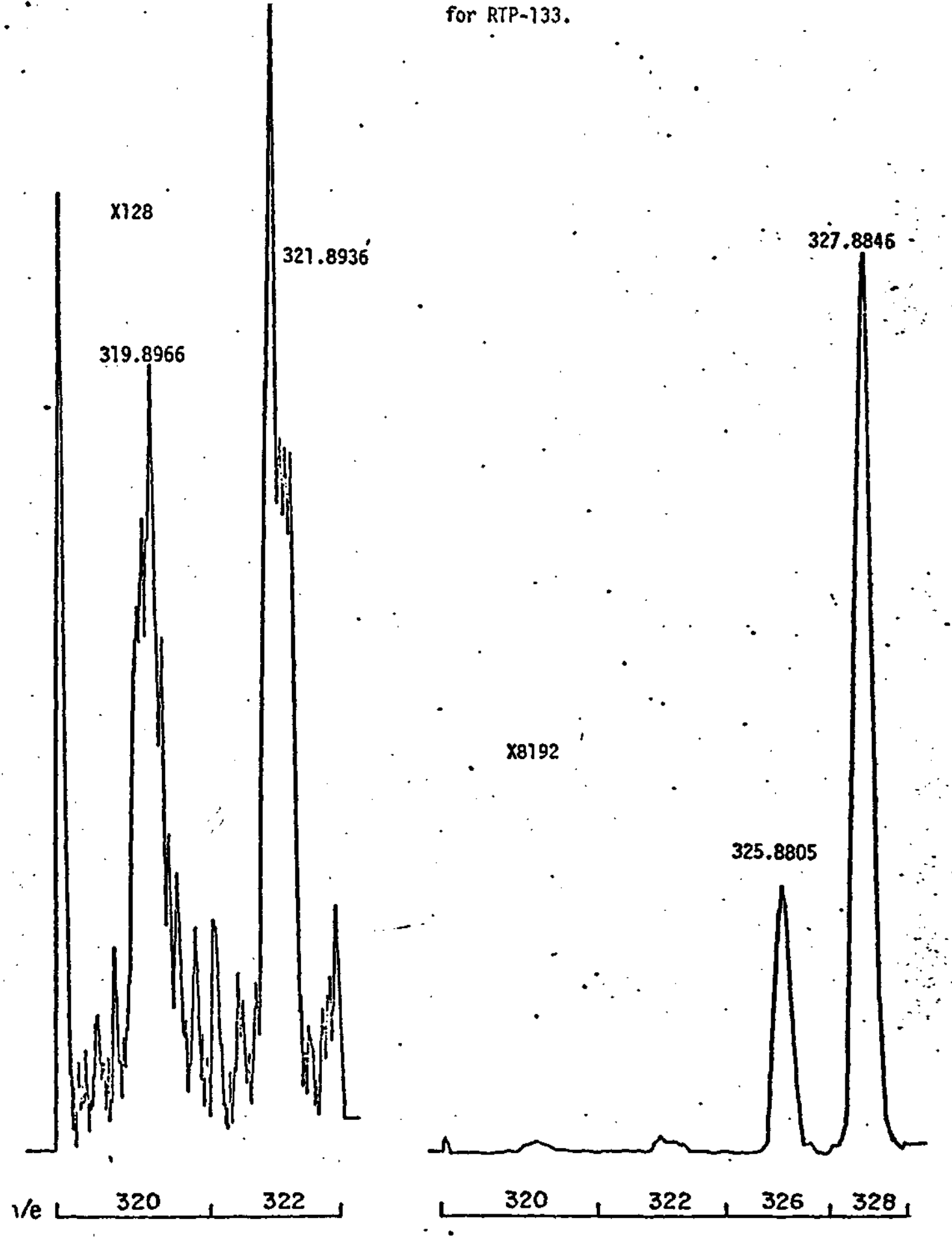

X128
321.8936
319.8966
X8192
327.8846
325.8805
m/e
320
322
320
322
326
328

Fig. 4. GC-HRMS Four-Peak Monitoring Results Obtained for the Solvent Blank Analyzed Immediately Following Analysis of RTP-133.

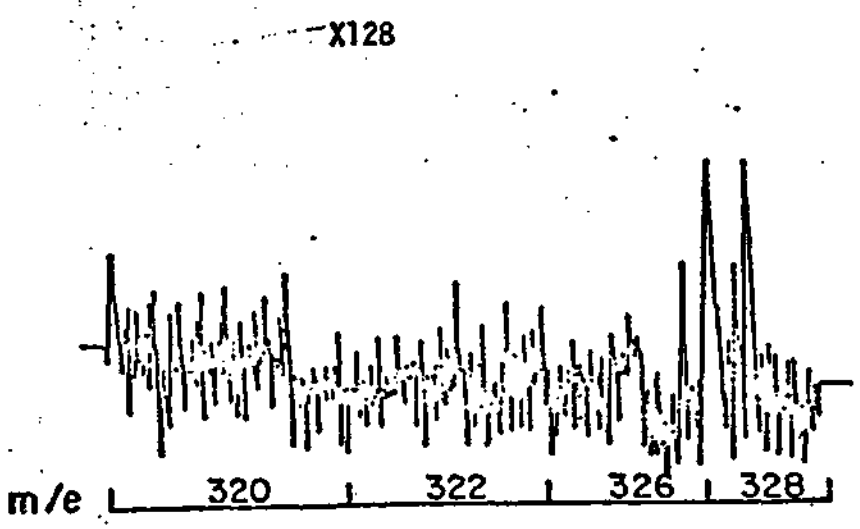
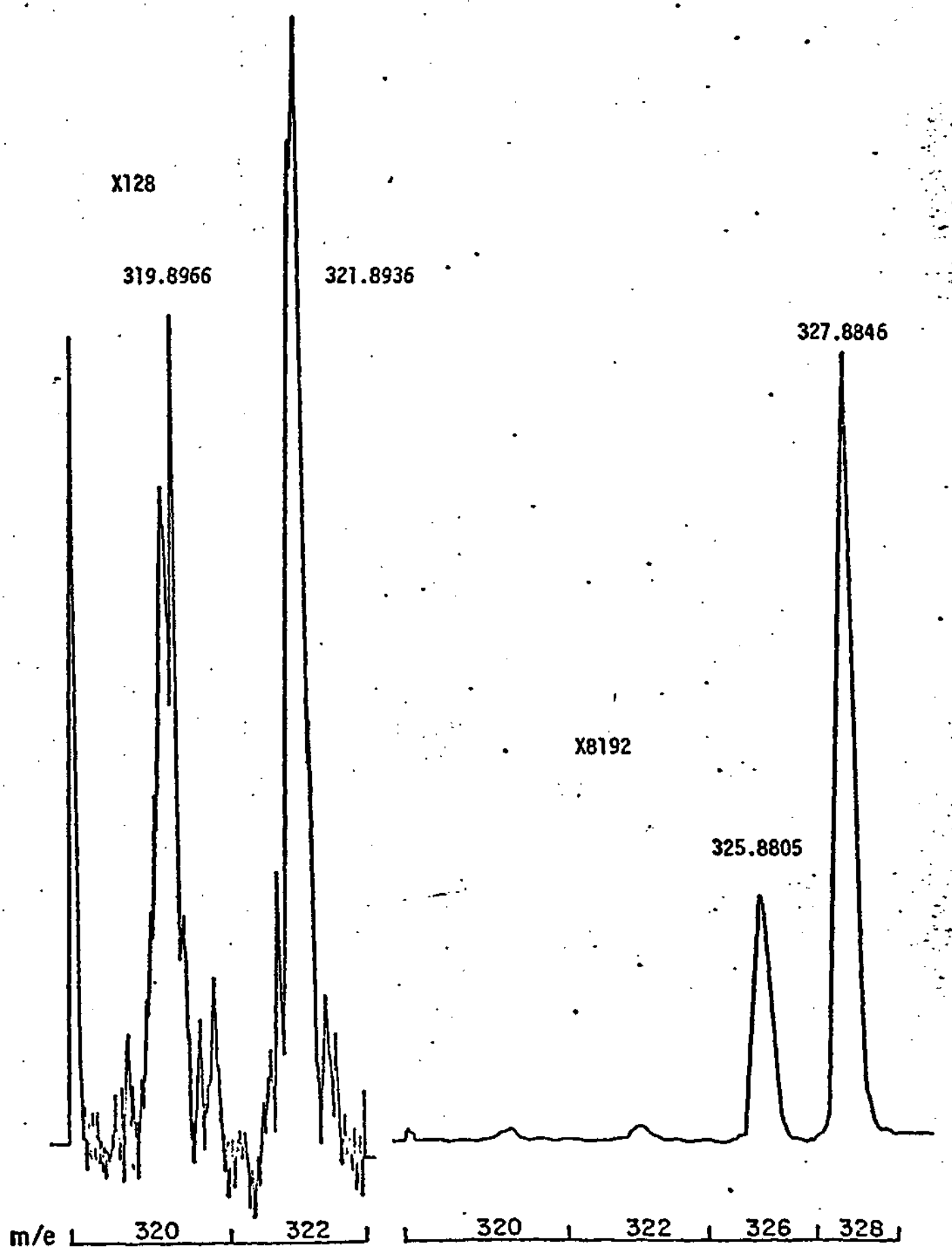



Fig. 5. GC-HRMS Four-Peak Monitoring Results Obtained for [illegible]