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INHALATION HAZARD EVALUATION OF PYRAX/INSECTICIDE DUST DURING A--ETC(U)
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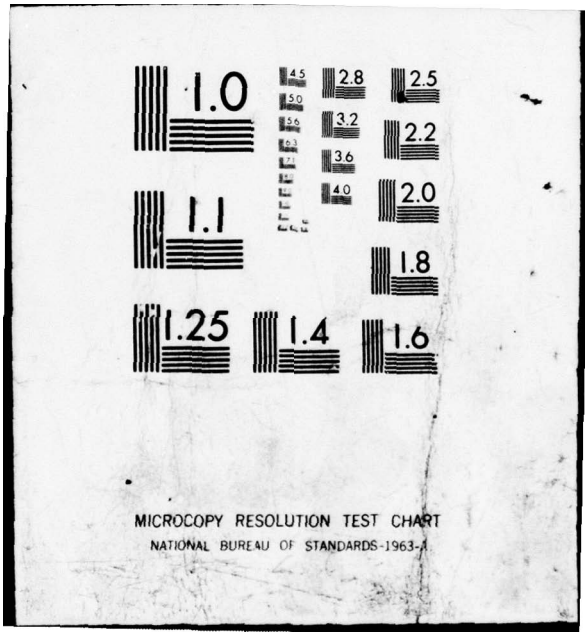
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INHALATION HAZARD EVALUATION OF PYRAX/INSECTICIDE DUST DURING A SIMULATED DELOUSING EXPOSURE

STUDY NO. 51-1302-78
JUNE 1977 - DECEMBER 1977

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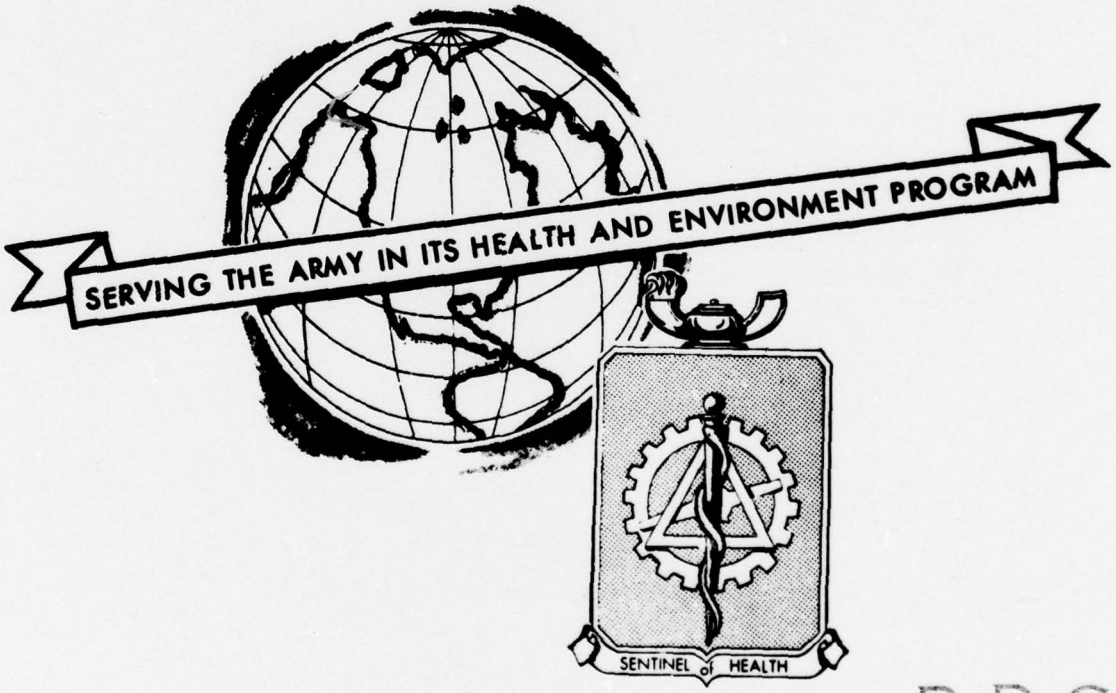

US ARMY
ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD 21010

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Macko/ag/584-3980

30 JAN 1978

HSE-LT/WP

SUBJECT: Inhalation Hazard Evaluation of Pyrax/Insecticide Dust During A Simulated Delousing Exposure, Study No. 51-1302-78, June 1977 - December 1977

Executive Secretary
Armed Forces Pest Control Board
Forest Glen Section, WRAMC
Washington, DC 20012

A summary of the pertinent findings and recommendations of the inclosed report follows:

The inhalation hazard of a Pyrax/Insecticide dust exposure from a standard pediculicide treatment was investigated by this Agency. A 16-point delousing treatment using untreated Pyrax® ABB powder was performed on a fatigue clad styrofoam dummy. Particulate air samples were collected at the breathing zones of the subject and operator. The count median diameters of the collected dust samples were determined both by a Model PDS-100 Particle Data System and by direct microscopic examination. Particulate median diameters using those procedures ranged from 8.8 to 12.3 micrometers, and 3.8 to 5.8 micrometers, respectively. Mass concentrations of the untreated powder, analysed gravimetrically, ranged from .16 mg/l to .24 mg/l at the breathing zone of the subject and .04 to .27 mg/l at the breathing zone of the operator. Mass concentration sampling of the untreated pyrax powder indicates little probability of exceeding the threshold limit of 10 mg/m^3 for ABATE listed in the Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977, if the proposed 2 percent ABATE pyrax powder was employed. The mass concentration samples taken of the untreated pyrax powder did exceed the Occupational Safety and Health Administration standard for concentrations of Inert or Nuisance Dust (15 mg/m^3 Total Dust) given in Title 29, Code of Federal Regulations, 1976 ed., Section 1910.1000, Air Contaminants. It is recommended that respiratory protection be utilized by the operator of the dusting equipment during the pediculicide treatment.

FOR THE COMMANDER:

Brendan E. Joyce

BRENDAN E. JOYCE, Ph.D.
LTC, MSC
Director, Laboratory Services

1 Incl
as (5 cy)

CF:
HQDA (DASG-HCH)
Cdr, HSC (HSPA-H)
Supt, AHS (HSA-IHE)
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Inhalation Hazard Evaluation	New May Porton Graticule
Pyrax® ABB Powder	simulated pediculicide treatment
ABATE	geometric mean diameter
count median diameter	Inert or Nuisance Dust
mass concentration	Threshold Limit Values

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The inhalation hazard of a Pyrax/Insecticide dust exposure from a standard pediculicide treatment was investigated by this Agency. A 16-point delousing treatment using untreated Pyrax® ABB powder was performed on a fatigue clad styrofoam dummy. Particulate air samples were collected at the breathing zones of the subject and operator. The count median diameters of the collected dust samples were determined both by a Model PDS-100 Particle Data System and by direct microscopic examination. Particulate median diameters using those procedures ranged from 8.8 to 12.3 micrometers, and 3.8 to 5.8 micrometers,

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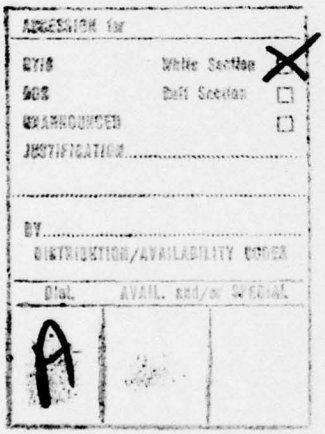
respectively, Mass concentrations of the untreated powder, analysed gravimetrically, ranged from .16 mg/l to .24 mg/l at the breathing zone of the subject and .04 to .27 mg/l at the breathing zone of the operator. Mass concentration sampling of the untreated pyrax powder indicates little probability of exceeding the threshold limit of 10 mg/m^3 for ABATE listed in the Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977, adopted by the American Conference of Governmental Industrial Hygienists, if the proposed 2 percent ABATE pyrax powder was employed. The mass concentration samples taken of the untreated pyrax powder did exceed the Occupational Safety and Health Administration standard for concentrations of Inert or Nuisance Dust (15 mg/m^3 Total Dust) given in Title 29, Code of Federal Regulations, 1976 ed., Section 1910.1000, Air Contaminants. It is recommended that respiratory protection be utilized by the operator of the dusting equipment during the pediculicide treatment.



DEPARTMENT OF THE ARMY
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ABERDEEN PROVING GROUND, MARYLAND 21010

HSE-LT/WP

INHALATION HAZARD EVALUATION OF PYRAX/INSECTICIDE DUST DURING A SIMULATED DELOUSING EXPOSURE
STUDY NO. 51-1302-78
JUNE 1977 - DECEMBER 1977

1. AUTHORITY. Letter, AFPCB, Armed Forces Pest Control Board, 13 September 1976, subject: Investigational New Drug Application for ABATE Pediculicide.

2. REFERENCES.

a. TM 5-632, Military Entomology Operational Handbook, December 1971.

b. Technical Data Sheet, R. T. Vanderbilt Company Bulletin No. 100, subject: Pyrax®.*

c. Letter, United States Department of Agriculture, Beltsville, MD, 3 June 1977, subject: Particle Analysis.

3. PURPOSE. The purpose of this study was to obtain data upon which to evaluate possible inhalation hazards to a duster and subject from a 16-point delousing treatment using untreated Pyrax ABB powder. The Model PDS-100 particle data system and a visual microscopic method of analysis for determining particulate count median diameters (cmd) were also compared.

4. BACKGROUND.

a. The Armed Forces Pest Control Board (AFPCB) is coordinating the registration of a pediculicide (ABATE®†) with the Food and Drug Administration (FDA). A 2 percent ABATE, 98 percent Pyrax formulation of this compound is to be used for the control of human lice in military programs. Negotiations with FDA for a field test program have resulted in the development of an Investigational New Drug Application (IND).

b. The US Army Environmental Hygiene Agency was requested to investigate the possible inhalation hazards of a Pyrax/insecticide dust that might occur during a group treatment. A group treatment involves the dusting of infested individuals by an operator using powder dusting equipment. It has been approximated that, using this method, 31 gram of formulated dust (0.62 gm active ingredient) are applied to each individual (paragraph 1).

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* Pyrax is a registered tradename of Standard Mineral Company, Robbins, NC.
† ABATE is a registered tradename of American Cyanamid Co., Princeton, NJ.

5. METHOD.

a. The following dusting procedure is taken from TM 5-632 (reference paragraph 2a). "Dusting of personnel should follow a definite routine to avoid missing portions of the clothing. A suggested procedure which may be modified as the situation warrants, is outlined in the following steps:

(1) Direct personnel to loosen collar, tie, and belt, and then stand with hat in hand.

(2) First, dust the head, separating the hair to insure even distribution. The hair should be whitened with the dust.

(3) Then dust the inside of the hat.

(4) Insert nozzle into right sleeve next to skin, with the subject's arm outstretched to the side at shoulder height, and direct powder toward the armpit. Hold the trigger of the powder duster down until powder is seen to issue from the loosened neck of the shirt. The subject's face should be turned away from the side being dusted. Repeat for the left sleeve.

(5) Insert nozzle in the front of the shirt at collar and direct the powder toward the right armpit, toward the stomach, and toward the left armpit. Operator stands in front, and the subject leans forward with head tipped back.

(6) Insert nozzle in the front of the trousers, next to the skin, and direct powder toward the right leg, toward the pubic region, and toward the left leg.

(7) Insert nozzle in the back of the shirt at collar and direct the powder toward the right shoulder, toward the small of the back, and toward the left shoulder. Operator and subject remain in same relative position as above, but with head of subject bent on chest. Powder should be dusted on collar itself where lice frequently are found.

(8) Insert nozzle in the back of the trousers, next to skin, and direct powder toward the right leg, toward the buttocks areas, and toward the left leg."

b. The particles in the breathing zones of the operator and the subject in this procedure have not to our knowledge been characterized as to their particle size or mass concentration. This characterization is necessary to show the potential for deposition of particles in the lungs of individuals involved with the automatic pyrax/insecticide applications.

c. For safety purposes, a US Army fatigue-clad styrofoam dummy was used as a subject and positioned upright in an open field. Pyrophyllite (Pyrax ABB) powder, a hydrous aluminum silicate (obtained from Leslie R. Swain, Jr., Insects Affecting Man Research Lab, Gainesville, Florida) was used as the dusting material (reference paragraph 2b). The Army's 16-point dusting procedure was performed using a gasoline engine-powered delousing outfit (Johnson Service Co., Model 252 QM with a Wisconsin Engine Model MACND) equipped with ten delousing guns.

d. Air samples were collected by means of a portable vacuum pump (Bendix, Type 3900-10, Serial No. 11827) attached to the belt of the dummy and another pump (MSA, Model G, Part No. 456058) attached to the belt of the operator. Plastic tubing was used to attach the portable vacuum pumps to filter holders (Gelman Instrument Co., Model 1220) containing Millipore filters (AABG 0 47 00, AA 0.8 micrometers, Black grid, 47 mm). The filter holders were positioned over the ear of the dummy facing down and through the lapel of the operator also facing down to sample the breathing zones of the individuals. During each exposure the operator wore a 3m Nuisance Odor Mask, No. 8713.

e. The indicated samples were taken and the exposure series described below.

(1) Exposure 1 (Sample 1 for subject's breathing zone, Sample 2 from operator's breathing zone). Total depositions from a single 16-point procedure, described in TM 5-632;

(2) Exposure 2 (Sample 3 from subject's breathing zone and Sample 4 from operator's breathing zone) total deposition from ten 16-point sprayings;

(3) Exposure 3 (Sample 5) total deposition from a direct spray into the open sample filter from 5 feet for 10 seconds;

(4) Exposure 4 (Sample 6) total deposition from a direct spray into the open sample filter from 2 feet for 5 seconds;

(5) Exposure 5 (Sample 7) total deposition from a direct spray into an open sample filter from 2 feet for 5 seconds.

f. Sample numbers 1 through 4 were collected to measure the cmd of the particulates in the breathing zones of an operator and subject during different periods of exposure. Sample Numbers 5 through 7 were collected to measure the cmd of the particulates dispersed from the power dusting equipment (Appendix C).

g. Sample Numbers 1, 3, 5, 6 and 7 were simultaneously characterized for a particulate cmd by Henry J. Retzer, Agricultural Engineer (Department of

Agriculture, Beltsville, MD.) using a Model ASSP-100 probe and a Model PD 5-100 Particle Data System made by Particle Measuring Systems, Inc., of Boulder, Colorado. The collection point for this instrument was 6 inches behind the filter holder mounted on the dummy. Data was immediately available after each sampling in the form of a computer printout (Appendix D).

h. After the dust samples for cmd analysis were collected on the filters, a light microscope with a mechanical stage and ocular New May/Porton graticule (Figure, page 5) was calibrated (Appendix B) and used to determine the particulate size distributions. A pie-shaped section of the sample filter was placed on a slide, a cover slip positioned on the specimen and observed at 430 magnification with a direct beam light source. A minimum of 200 particles were randomly counted and visually compared with the graticule globes for sizing purposes. Particles were listed according to globe sizes then converted into micrometers. Log - probability graph paper was used to calculate the experimental data. The particle size at the 50 percent point of the cumulative curve represents the geometric mean diameter (cmd). The geometric standard deviation can then be given by the formula

$$\text{Standard Deviation} = \frac{\text{84.13 percent size}}{\text{50 percent size}} = \frac{\text{50 percent size}}{\text{15.8 percent size}}$$

i. Eight additional samples were collected on preweighted filters at the breathing zones of the operator and the styrofoam subject.

(1) Exposure Nos. 8 and 9 were collected from the 16-point dusting procedure described in TM 5-632 (reference paragraph 2a)(Samples 10 and 12 from the subject's breathing zone)(Samples 9 and 11 from the operator's breathing zone)(Appendix E).

(2) Exposure Nos. 10 and 11 were collected from the 16-point dusting procedure performed 10 times (Samples 14 and 16 from the subject's breathing zone)(Samples 13 and 15 from the operator's breathing zone).

j. The purpose of this second group of exposures was to calculate the concentrations of particles present in the breathing zones of the subject and operator.

k. After each exposure, the premeasured filters were removed from the holders and placed in small sample containers in a desicator overnight. The following day filter weights were determined and weight gains and particulate concentrations calculated (Appendix E).

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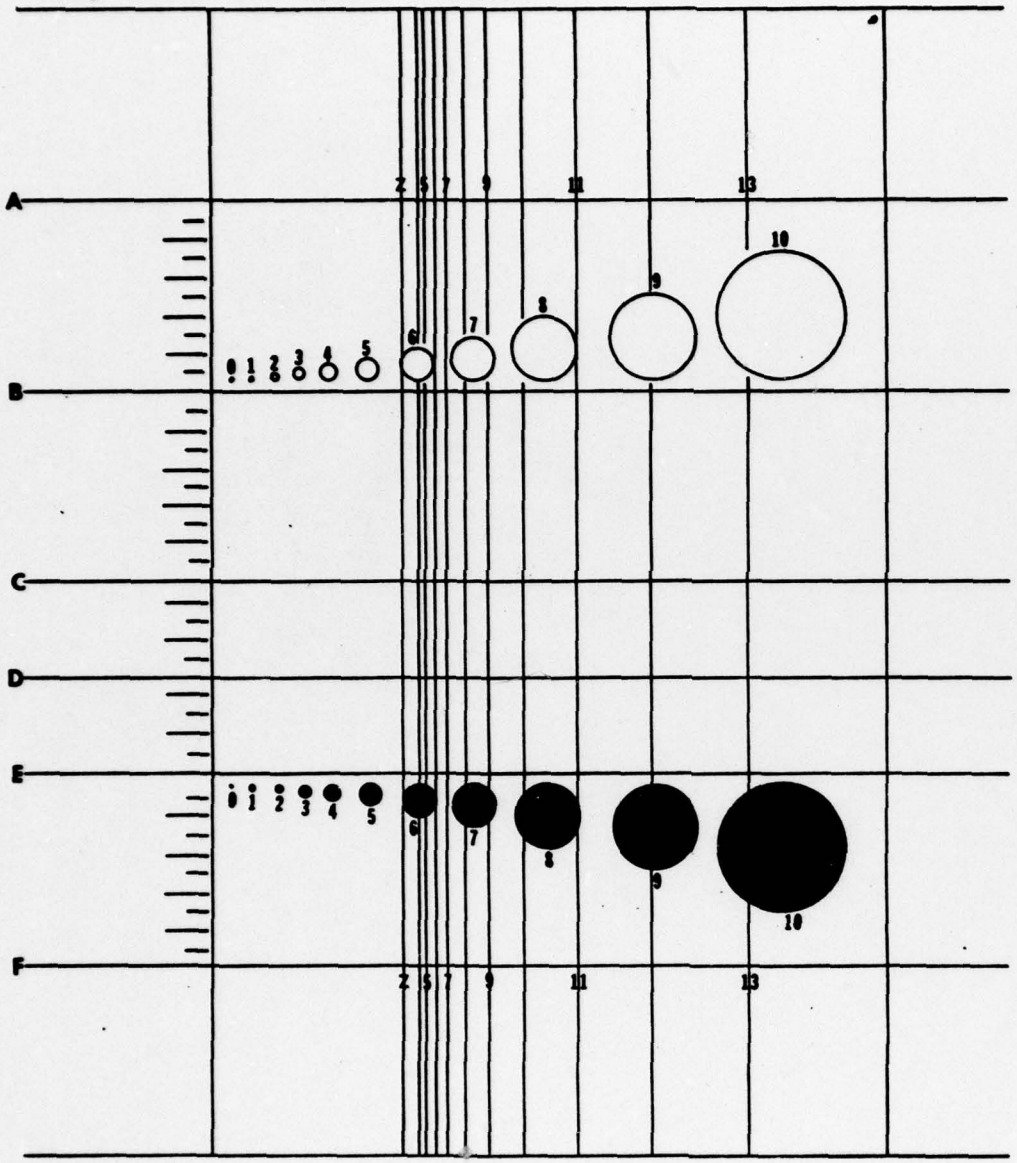

FIGURE. NEW MAY/PORTON GRATICULE

6. SUMMARY OF FINDINGS. The inhalation hazard of a Pyrax/Insecticide dust exposure during a simulated pediculicide treatment was investigated by this Agency. Samples taken in the breathing zones of a subject (Sample 1) and an operator (Sample 2) during a simulated treatment were found to have 3.8 and 4.2 micrometer cmd respectively. Characterization of the dust emitted from a power dusting unit (Sample 5) was found to have a 5.8 micrometer cmd. The median diameters determined by direct microscopic analyses were 43 and 47 percent of those obtained by the Particle Data System (Appendix D). The mass concentrations during a typical 16-point spray procedure were determined to be approximately .20 mg/l (at the breathing zone of the subject) and .17 mg/l (at the breathing zone of the duster)(Appendix E). Definitions of selected terms and abbreviations used in this report are found in Appendix A.

7. DISCUSSION.

a. During the simulated dusting exposure particles between the range of 1 to 78 micrometer were observed. The cmd ranged from 3.8 to 5.8 micrometers. Particles between the range of 1 to 2 micrometers are noted as having the highest percentage of penetration and deposition in the pulmonary air spaces. Larger particles have a tendency to be trapped in the upper respiratory system and smaller particles have less tendency to be trapped in any portion of the respiratory system. Only a very small percentage (approximately 20 percent) of the particles observed were in this critical range of 1 to 2 micrometers.

b. The cmd calculated by visual microscopic analysis were lower (43 and 47 percent) than the values obtained by the Particle Data System. Mr. Retzer informed us that he used the Particle Data System to analyse other dust samples and obtained results 60 percent higher than their known values. It, therefore, appears that this automated system is not suitable for dust particulate evaluation (reference paragraph 2c).

c. The mass concentration deposited during a typical 16-point spray procedure was determined to be approximately .20 mg/l (at the breathing zone of the subject) and .17 mg/l (at the breathing zone of the operator). It is important to note that the dose inhaled by the operator would be directly proportional to the number of subjects dusted (approximately 4 mg per subject)(Appendix E).

d. Exposure to ABATE found in the pyrax dusting material at the 2 percent level during a typical delousing procedure at the concentrations observed during the simulated exposure are not expected to exceed the threshold limit value of 10 mg/m^3 for ABATE listed in the Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977.

e. All of the samples taken did exceed the standard for concentrations of Inert or Nuisance Dust (15 mg/m^3 Total Dust) given in Title 29, Code of Federal Regulations, 1976 ed., Section 1910.1000, Air Contaminants. This does indicate a possible health hazard.

8. RECOMMENDATION. The standard for Inert or Nuisance Dust is exceeded in the breathing zones of the subject and the dusting personnel. It is recommended that respiratory protection be utilized by the operator of the powder dusting equipment because of his prolonged contact with the dust cloud of the pyrax/insecticide powder.

Joseph A. Macko Jr.

JOSEPH A. MACKO, JR.
Biologist
Toxicology Division

John Harvey

JOHN HARVEY
Biological Laboratory Technician
Toxicology Division

APPROVED:

Arthur H. McCreesh

ARTHUR H. McCREESH, Ph.D.
Chief, Toxicology Division

APPENDIX A

GLOSSARY OF RECURRING DEFINITIONS, ABBREVIATIONS AND SYMBOLS USED BY THE TOXICOLOGY DIVISION, USAEHA

Definitions of medical terms and abbreviations used in this report are in agreement with the Stedman's Medical Dictionary, Twentieth Edition, published by the Williams and Wilkins Company. The following terms and abbreviations are either not found in the above references or have been modified to fit the special purposes of this report. Some of the terms have been included below for special emphasis.

DEFINITIONS

WORD	DEFINITION
Count Median Diameter	The value of the diameter of a particle analysis for which the verticle coordinate divides the area of a percentage distribution curve into halves with respect to the surface
Geometric Mean Diameter	Same as the count median diameter
Graticule	A glass plate inscribed with a series of circles and rectangles.

ABBREVIATIONS

ABBREVIATION	MEANING
cmd	Count Median Diameter
d	One unit of the basic scale of the New/May Porton Graticule. The distance from lines A to F on the graticule divided by 200.
gm	gram
l	liter of air
mg	milligram
mm	millimeter
µm	micrometer
lpm	liters per minute

SYMBOLS

SYMBOLS	MEANING
>	is greater than
<	is less than

APPENDIX B

CALIBRATION OF OCULAR GRATICULE. To determine the accurate size of particulate matter, it was necessary to calibrate the microscope. The graticule was positioned in a ten power eye piece and used with a Bausch and Lomb stage micrometer (0.1, .01 mm) to calibrate the microscope for particle sizes. The diameter of the globe "o" on the New/May Porton Graticule (Figure, page 5) is equal to one unit (d) of the basic scale of that graticule. The distance from lines A to F was 200 (d) basic units. This distance is measured with the stage micrometer for each objective power to calibrate and set equal to 200 d. From these figures, the actual size of d, or one basic unit can be calculated using the following formula.

$$200\ d = x \text{ micrometers}$$

The size ranges (n) of the globes increase with a $\sqrt{2}$ progression and these are numbered according to the power of $\sqrt{2}$ they represent. The size in graticule units (D) for each n can be found by the formula:

$$D = \sqrt{2^n}$$

In order to calculate the actual size of a particle as compared with the different circle size (n) on the graticule, the size in graticule units D for each n is multiplied by the actual size of one graticule unit (d).

$$dD = \text{actual size of each n.}$$

APPENDIX C

PARTICULATE MEAN DIAMETER
VISUAL MICROSCOPIC METHOD

	Sample No. 1			Sample No. 2			Sample No. 5		
Size	No. Particles	Total	Cum %	No. Particles	Total	Cum %	No. Particles	Total	Cum %
.9	16	16	8	6	6	3	4	4	2
1.2	21	37	18	18	24	11	6	10	5
1.7	22	59	29	26	50	22	14	24	12
2.4	13	72	36	18	68	31	20	44	21
3.5	21	93	46	26	94	42	18	62	30
4.9	18	111	55	34	128	57	26	88	42
6.9	24	135	67	40	168	75	26	114	55
9.8	28	163	81	24	192	86	28	142	68
13.8	21	184	91	22	214	96	32	174	84
19.5	12	196	97	6	220	99	16	190	91
27.6	4	200	99	1	221	99	12	202	97
39.0	0	200	99	0	221	99	4	206	99
55.1	1	201	99	2	223	100	2	208	100
78.1	1	202	100						

SAMPLE NO. 1	SAMPLE NO. 2	SAMPLE NO. 5
15.87% size = 1.4	15.87% size = 1.4	15.87% size = 2.0
50% size = 3.8	50% size = 4.2	50% size = 5.8
84.13% size = 10.1	84.13% size = 9.5	84.13% size = 15.2

NOTE: Sample Filters 3, 4, 6 and 7 were too dense for accurate particulate cmd determinations. The pyrax dust microscopically examined can be described as crystalline, translucent and very irregular in shape.

APPENDIX D

PARTICULATE MEAN DIAMETER
AUTOMATED METHOD

	Sample No. 1			Sample No. 3		
Size	No. Particles	Total	Cum %	No. Particles	Total	Cum %
1- 3.0	4	4	1	58	58	4
3- 5.0	159	163	9	1334	1392	9
4- 7.0	455	618	34	3689	5081	33
7- 9.0	373	991	54	3308	8389	55
9-11.0	298	1289	70	2401	10790	70
11-13.0	172	1461	79	1541	12331	80
13-15.0	117	1578	86	1086	13417	87
15-17.0	95	1673	91	651	14068	92
17-19.0	57	1730	94	438	14506	94
19-21.0	37	1767	96	294	14800	96
21-23.0	33	1800	98	211	15011	98
23-25.0	19	1819	99	152	15163	99
25.27.0	12	1831	99	102	15265	99
27-29.0	7	1838	99	50	15315	99
29-31.0	6	1844	100	67	15382	100

SAMPLE NO. 1

50 % = 8.8
SD = 0.4609

SAMPLE NO. 3

50% = 8.8
SD = 0.4577

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PARTICULATE MEAN DIAMETER
AUTOMATED METHOD

	Sample No. 5			Sample No. 6			Sample No. 7		
Size	No. Particles	Total	Cum %	No. Particles	Total	Cum %	No. Particles	Total	Cum %
1- 3.0	2	2	1	13	13	1	1	1	1
3- 5.0	11	13	4	34	47	3	11	12	8
5- 7.0	30	43	12	108	155	11	32	44	29
7 -9.0	56	99	27	180	335	24	35	79	52
9-11.0	50	149	41	251	586	42	31	110	72
11-13.0	39	188	51	204	790	57	21	131	86
13-15.0	43	231	63	196	986	71	12	143	94
15-17.0	28	259	70	150	1136	82	1	144	95
17-19.0	33	292	79	97	1233	88	2	146	96
19-21.0	31	323	88	54	1287	93	1	147	97
21-23.0	14	337	92	48	1335	96	3	150	99
23-25.0	14	351	95	30	1365	98	0	150	99
25-27.0	4	355	97	10	1375	99	1	151	99
27-29.0	6	361	98	11	1386	99	0	151	99
29-31.0	7	368	100	4	1390	100	1	152	100

Sample No. 5	Sample No. 6	Sample No. 7
50% size = 12.3 SD = 0.4837	50% size = 11.6 microns SD = 0.4388	50% size = 8.7 microns SD = 0.4167

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APPENDIX E

MASS CONCENTRATION

	16 Point Spray		10x 16 Point Spray	
	Exposure 8	Exposure 9	Exposure 10	Exposure 11
Total Dusting Time	1.17 min 70 sec	1.28 min 77 sec	4.82 min 289 sec	4.90 min 294 sec
Subject				
Filter No.	10	12	14	16
Filter Wt. Gain	.0004 gm	.0004 gm	.0019 gm	.0013 gm
Vac Pump Rate	1.65 lpm	1.65 lpm	1.65 lpm	1.65 lpm
Particulate Concentration	.21 mg/l	.19 mg/l	.24 mg/l	.16 mg/l
Sprayer				
Filter No.	9	11	13	15
Filter Wt. Gain	.0006	.0002	.0004	.0013
Vac Pump Rate	1.90 lpm	1.90 lpm	1.90 lpm	1.90 lpm
Particulate Concentration	.27 mg/l	.08 mg/l	.04 mg/l	.14 mg/l