

PLAINTIFF'S EXHIBIT

MET-94

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PHL-345
A.F.
4/9/79

A STUDY OF DUST CONDITIONS
in the Manhela Plant
of the
UNITED STATES ASBESTOS & ROBER DIVISION OF THE RAYBESTOS-MANHATTAN,
INC.

1930

Exhibit J

The following report is a study of dust conditions in the
Manheim plant of the United States Asbestos & Rubber Division of the
Raybestos-Manhattan, Inc. This study was carried on during February,
1930, by the Industrial Health Service of the Metropolitan Life Insurance Company.

It is the third unit in a series of studies of the asbestos industry in the United States and Canada for the purpose of determining the extent and nature of atmospheric pollution to which asbestos workers are exposed and whether there can be demonstrated any harmful effect to such workers.

This study differs from the two preceding ones in that there were included physical examinations of employees, hence it is more complete and informative.

* * * * *

APPARATUS AND METHODS OF SAMPLING:

The impinger method⁽¹⁾ was used for collecting samples of dust in the air. This is accomplished by aspirating the air to be sampled, and impinging it upon a flat surface under a liquid of either distilled water or alcohol. In general whenever the dust collected is of a siliceous nature an alcohol-water mixture is used to prevent any silica going into solution. Pyrex flasks are used as containers to collect the samples, as experience has shown that this glass is, for all purposes, practically insoluble. The volume of air is measured by means of a flow meter or else a vacuum gauge and the air sample is aspirated by suction supplied either by an electrically driven pump or else by an ejector actuated by compressed air. Each dust sample collected represented a volume of air of from 50 to 80 cubic feet.

Due to the high concentrations of dust in the departments of this plant this size sample was found to be representative and of sufficient size for analysis. The impinger was placed in close proximity to and at the breathing level of the workmen.

Air samples were also taken with the electric precipitator⁽²⁾ for dust particle measurements. This instrument is designed upon the principle of the Cottrell precipitator. Air is drawn through an electrostatic field, where the dust particles are deposited upon a celluloid foil, by means of a small electrically driven pump. The volume of air sampled is measured by means

(1)*Comparative Tests of Instruments for Determining Atmospheric Dusts*, - Public Health Bulletin, No. 144, Treasury Dept., Washington, D.C.

(2)*Determination of Suspensoids by Alternating Current Precipitators*, - Philip Drinker and Robert W. Thomson, Journal of Industrial Hygiene, Vol. VII, No. 8, June, 1925.

of a flow meter. From 10 to 50 cubic feet of air were taken for a sample.

The collected dust samples were transported to the laboratory where total dust counts were made, and particle size measurements were taken. The results are tabulated and appear in graphs attached. The percentages of the various sized particles may be interpolated from these graphs.

Microphotographs of these dust particles were taken under high power and were further enlarged by being projected upon a screen by means of a lantern slide projector. The enlarged particles were then measured with a ruler. Knowing the entire enlargement (by actual measurement) it was possible to calculate the original particle size.⁽⁵⁾ By the use of Hazen's⁽⁴⁾ logarithmic probability paper, the logarithms of the function to be measured - in this case microns - are plotted as ordinates against the probability of occurrence as abscissae. Since the line is straight, extrapolation and interpolation of any desired region is facilitated.

It will be noted from these curves that from 86 to 99% of the particles are less than 10 microns in their greatest diameter.

The analyses are reported in total particles per cubic foot, and also in the corresponding weight of the dust in milligrams. There is no indicated relationship between the dust counts and the corresponding weights.

DESCRIPTION OF PLANT:

The plant at Mannheim consists of a number of one-story and two two-story buildings. One of the two-story buildings houses the offices, laboratories, dispensary and store room, while the other is devoted to the preparation

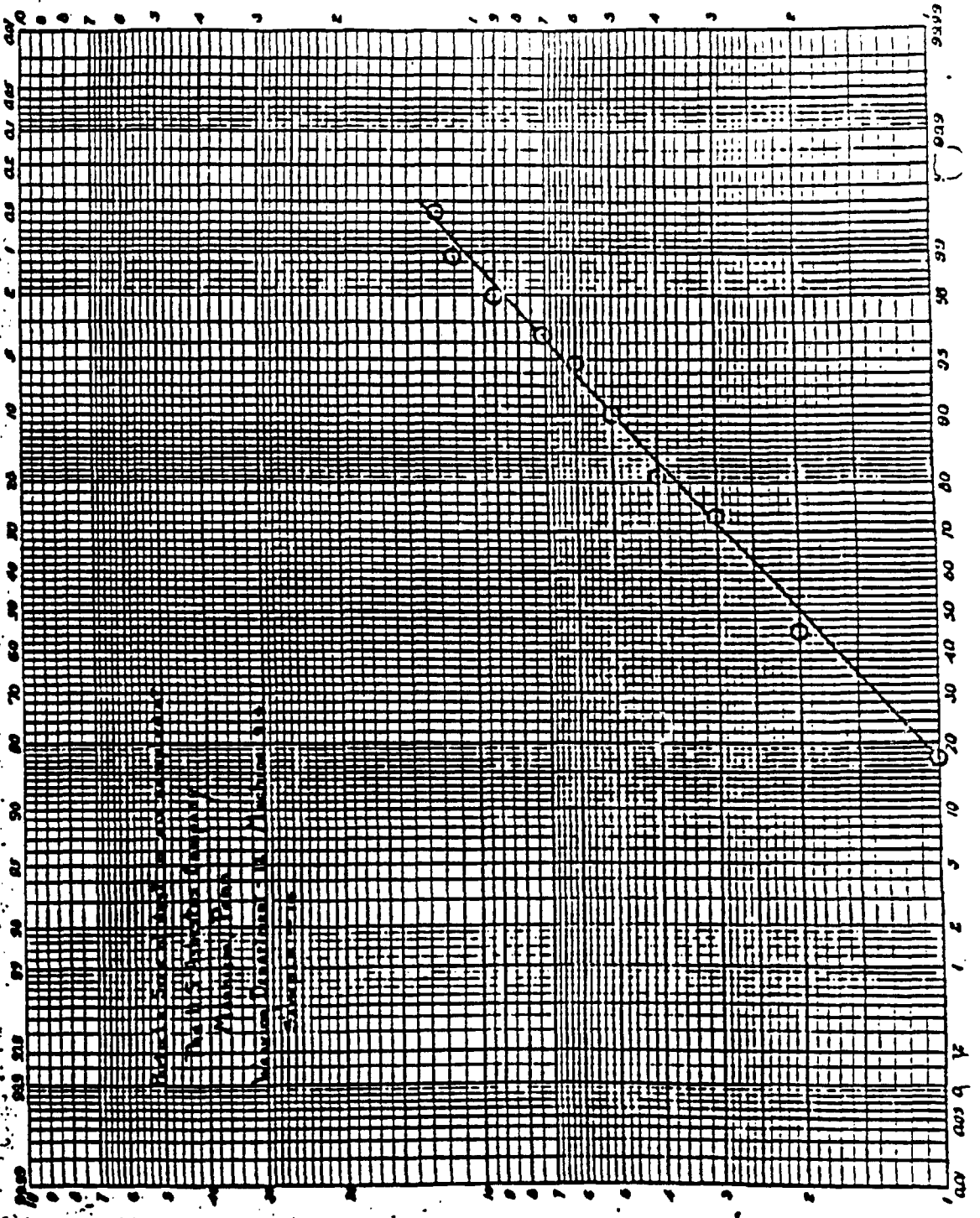
⁽⁵⁾Green, H. "A Photomicrographic Method for the Determination of Particle Size of Paint and Rubber Pigments", Journal Franklin Institute, 1921, 182, 657.

⁽⁴⁾Whipple, G.C. Vital Statistics. N.Y. John Wiley & Sons, Inc. 1925. p. 451

LOGARITHMIC PROBABILITY PAPER, No. 5118, DESIGNED BY HAZEN, WHIPPLE & FILLAM.



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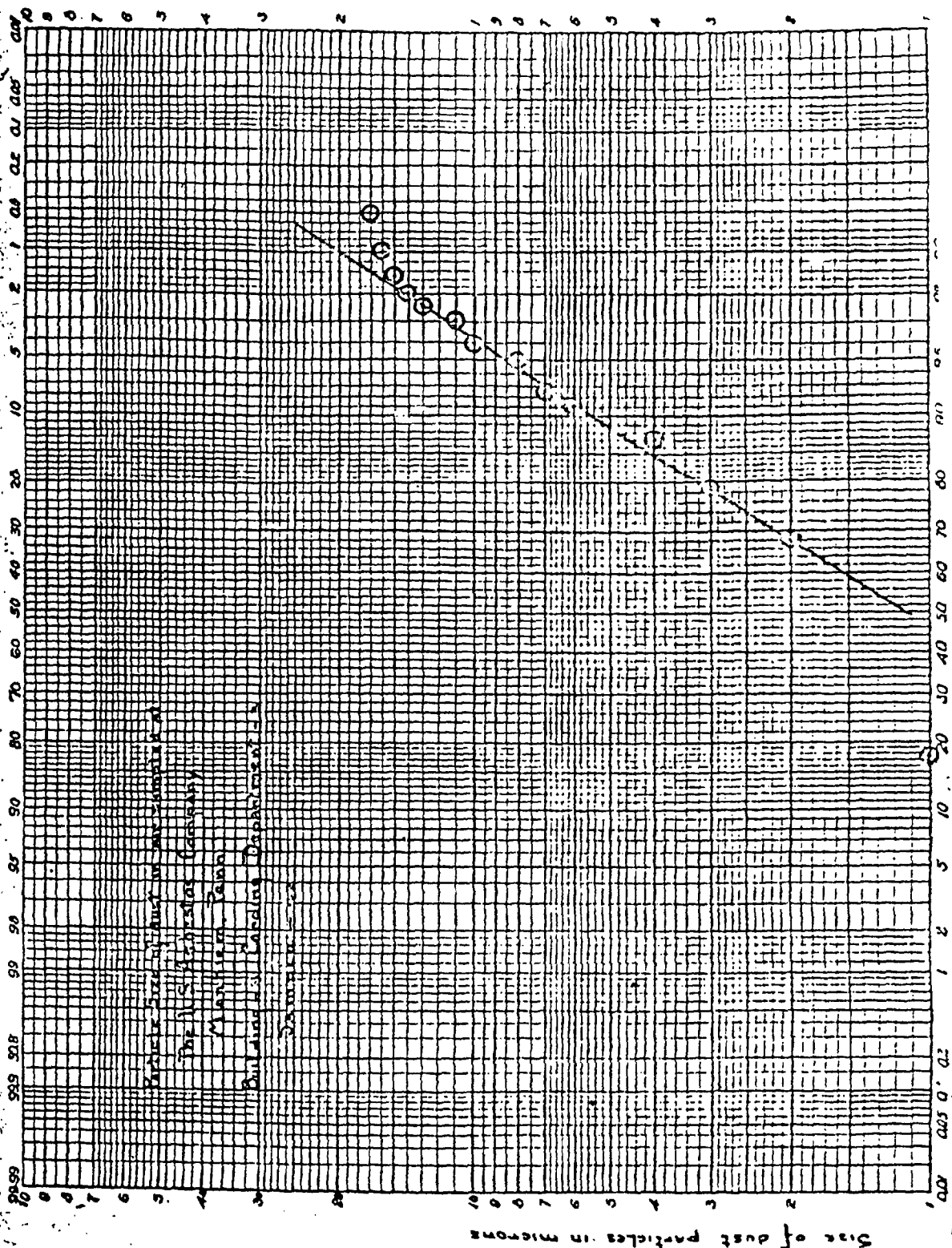


size of each particle in microns

LOGARITHMIC PROBABILITY PAPER NO. 2128

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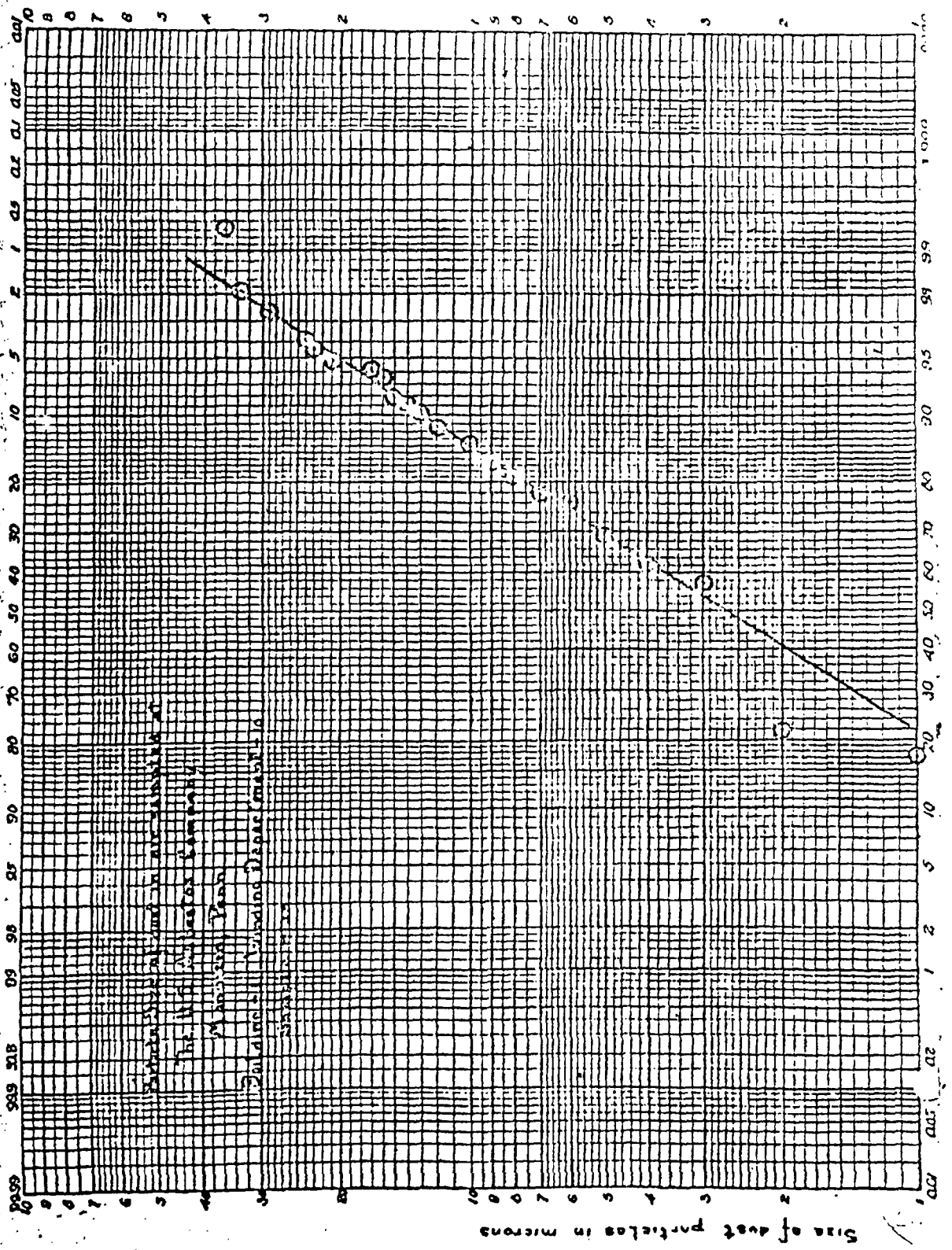
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LOGARITHMIC PROBABILITY PAPER, NO. 3128. DESIGNED BY HAZEN, WHITTLE & FULLER.



room and brake-band weave room on the first floor and the carding, spinning and spooling operations are performed on the second floor.

The other one-story buildings are occupied by spooling, twisting and broad loom operations, brake-band treating and packing manufacturing, shops and shipping department.

PREPARATION DEPARTMENT:

The asbestos is received in bags and emptied upon the floor. It is then shoveled into pug mills or chasers from which it is passed into an opener and on a shaker sieve. Here it is piled on the floor to be made up into mixtures with proportionate amounts of cotton which has already been passed through an opener. The batches of mixed cotton and asbestos are passed through a mixer picker and carried by suction through a pipe to bins in the card room on the second floor. In this suction pipe oil is applied to the mixture of cotton and asbestos by means of sprayers. Judging from the high dust counts found in the card room, as compared with those found at similar locations in the plant at Charleston, the method of applying the oil does not appear to be as effective.

Two card machines working on waste material are making wicking in this department. One loom is operating on brake-bands.

The exhaust systems at the various machines were only in partial operation due to relocation of machines. No humidifying system was in operation. The temperature of this department at the time of visit was 67° F. with a relative humidity of 57%, as compared with outdoor temperature of 88° F. and a relative humidity of 67%. The high incidence of dust in this department is partly due to the alterations being made.

TABLE NO. 1

PREPARATION ROOM

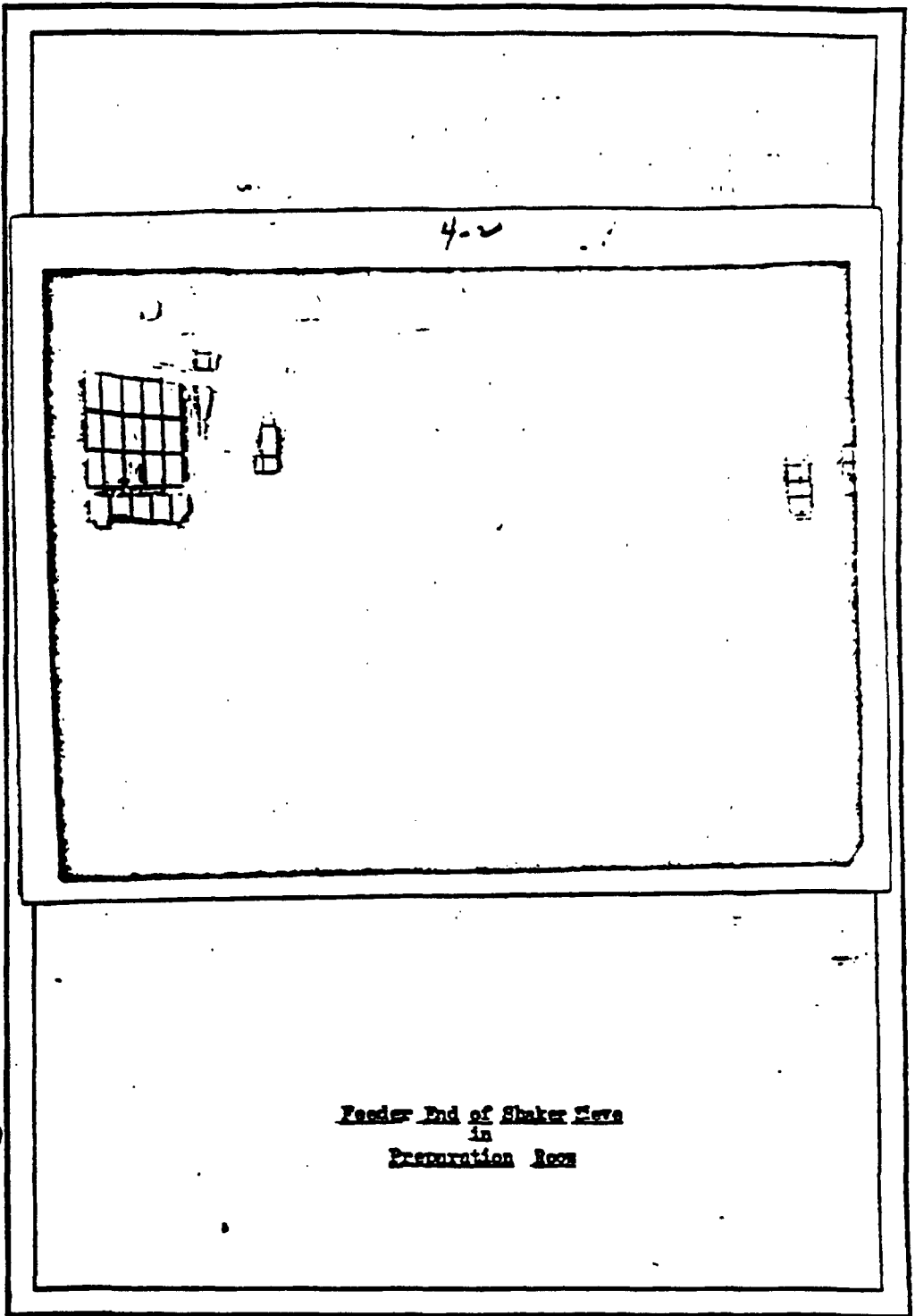
Sample No.	Building No.	Dept. No.	Location of Sampling	Total Counts of Dust Particles per cubic foot	Weight of Dust in milligrams per cubic foot
1	3	1	Alongside exhaust pipe from vertical opener discharging on to shaker sieve	45,259,154	2.5
3	3	1	Alongside loom 946. Only one loom in preparation room	2,201,597	.46
4	3	1	Alongside chasers #1 and 2	3,155,214	.47
5	3	1	At the side of shaker sieve	25,903,525	1.37
6	3	1	Floor mixing center of room	3,457,889	.45
8	3	1	Alongside feeder end of wick card working waste material, machine 136	3,047,129	.40
9	3	1	Machine #13, feeder hopper of breaker card	29,219,145	3.4
11	3	1	At the take off end of wick card machine #136	4,904,513	.95

4-1

4-1

Storage and Batch Mixing Bins
in
Preparation Room

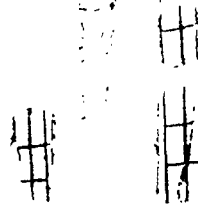
4-2



Feeder End of Shaker House
in
Preparation Room

4-3

4-3

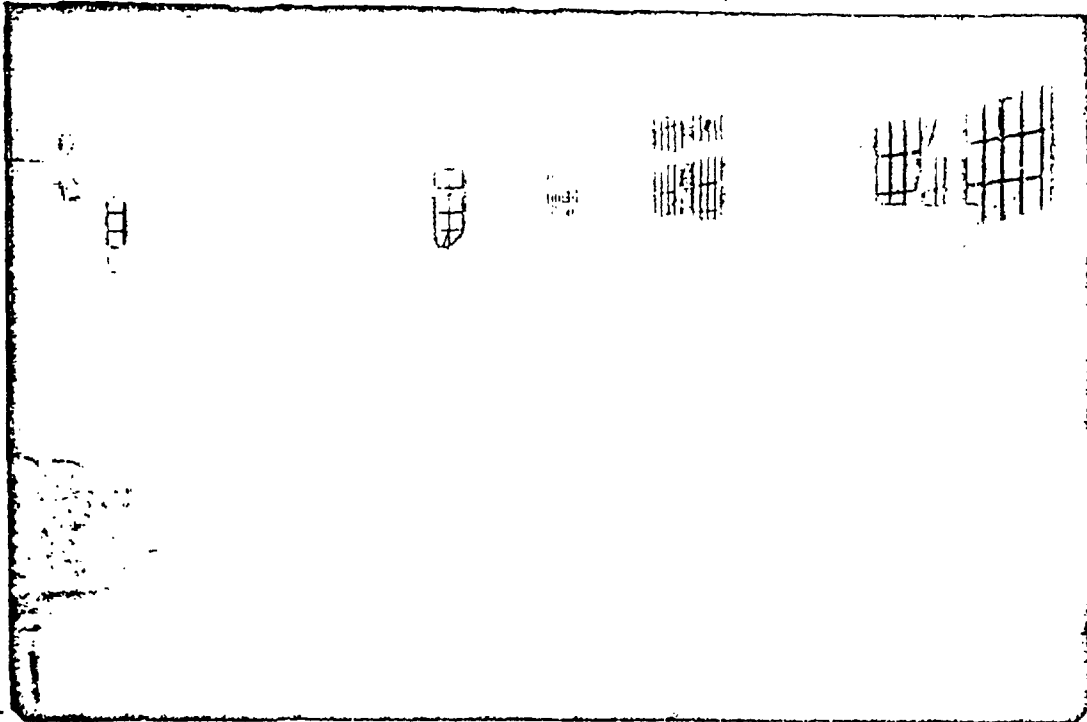


Take-off End of Shaker Sieve
Preparation Room

50

4-4

4-4



Floor Mixing in Preparation Room
Chaser or Pug Mill Visible at the Right

It will be noticed that the dust count is high in places and exceeds 10,000,000 particles, the standard adopted by the U.S. Public Health Service in their study of the granite industry.⁽⁵⁾

BRAKE-BAND WEAVING DEPARTMENT:

This process is conducted in a room adjacent to the preparation department. This room is equipped with hand controlled water sprays for humidifying. The temperature in this department was found to be 69° F. and the relative humidity was 76%.

Artificial illumination is furnished by Cooper Hewitt lamps.

Dust counts were collected in close proximity to the workers and are as follows:

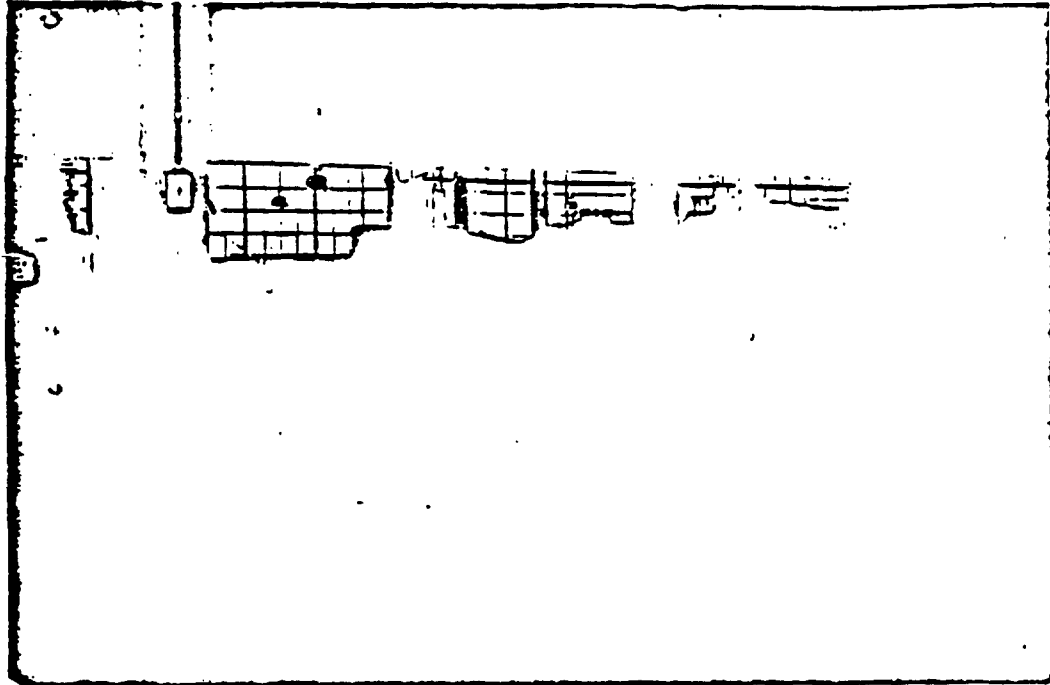
(5) Public Health Bulletin No. 187 "The Health of Workers in Dusty Trades II. Exposure to Siliceous Dust (Granite Industry)" - U.S.P.H.S., Treasury Dept., Washington, D.C. 1929.

TABLE No. 2
WEAVE ROOM (BRAKE BAND)

Sample No.	Building No.	Dept. No.	Location of Sample	Total Counts of Dust Particles per cubic foot	Weight of Dust in milligrams per cubic foot
12	1	12	Alongside loom 9 space 8. Machine #318	8,101,852	.80
15	1	12	Alongside loom 6 space 8. Machine #315	6,074,858	1.1
15	1	12	Alongside loom 5 space 12. Machine #325	4,824,606	.60
17	1	12	Front of loom 20 space 8. Machine #328	5,705,705	—
18	1	12	Front of loom 57 space 4. Machine #344	9,932,658	1.1
19	1	12	Front of loom 19 space 2. Machine #325	9,076,788	1.5

6-1

6-1



Brake-Band Moving

The number of particles per cubic foot of air in this room are considerably less than in the preparation room, and slightly under the standard quoted above.

SPOOLING, TWISTING AND BROAD LOOM WEAVING:

These processes are likewise carried out on the first floor of building number one. This department is equipped with the Carrier Air Conditioners which furnish ample humidification. The temperature was found to be 74° F. and the relative humidity was 50%.

TABLE No. 8

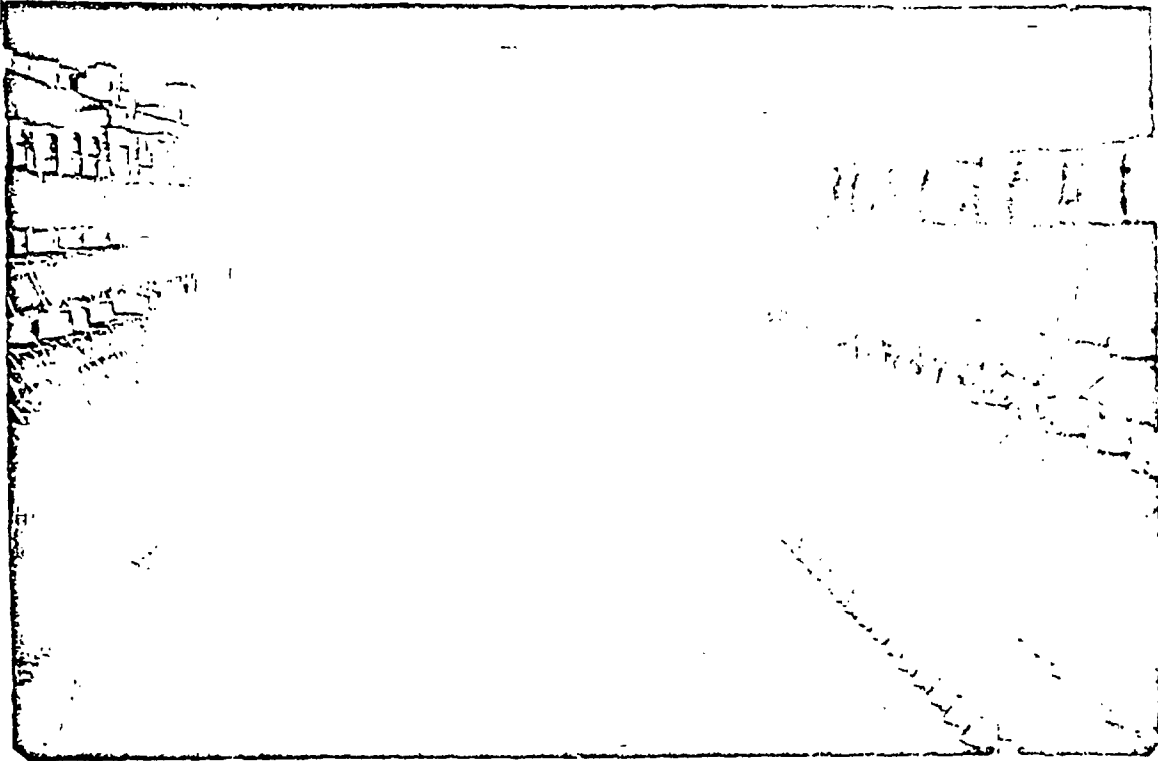
SPOOLING, TWISTING AND WEAVING

Sample No.	Building No.	Dept. No.	Location of Sample	Total Counts of Dust Particles per cubic foot	Weight of Dust in milligrams per cubic foot
20	1	6	Between spoolers 603 and 602	2,979,991	.65
21	1	6	Front of spooler #605	1,150,173	.25
22	1	10	Between universal winders 701 and 706	1,322,751	.30
24	1	7	Between twistors 660 and 661	3,732,638	.60
25	1	10	Alongside loom #1016 weaving broad cloth	2,270,489	.38
26	1	5	Alongside machine #451. Ring spinning	1,489,820	.35
28	1	10	Alongside loom #1017. (dry weaving)	3,182,870	.50
30	1	10	Between looms 5, 21 and 20 dry weaving on wide material	2,704,291	.50

First floor of building #1 equipped with the Carrier system.

8-1

8-1



Twisting Machines

The dust counts as shown in the table indicate a relatively small number of particles.

SPINNING DEPARTMENT:

This department is located on the second floor of building No. 1 at one end of the main card room.

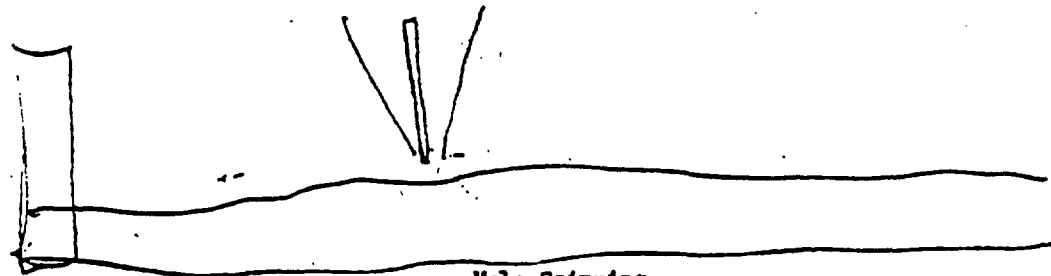
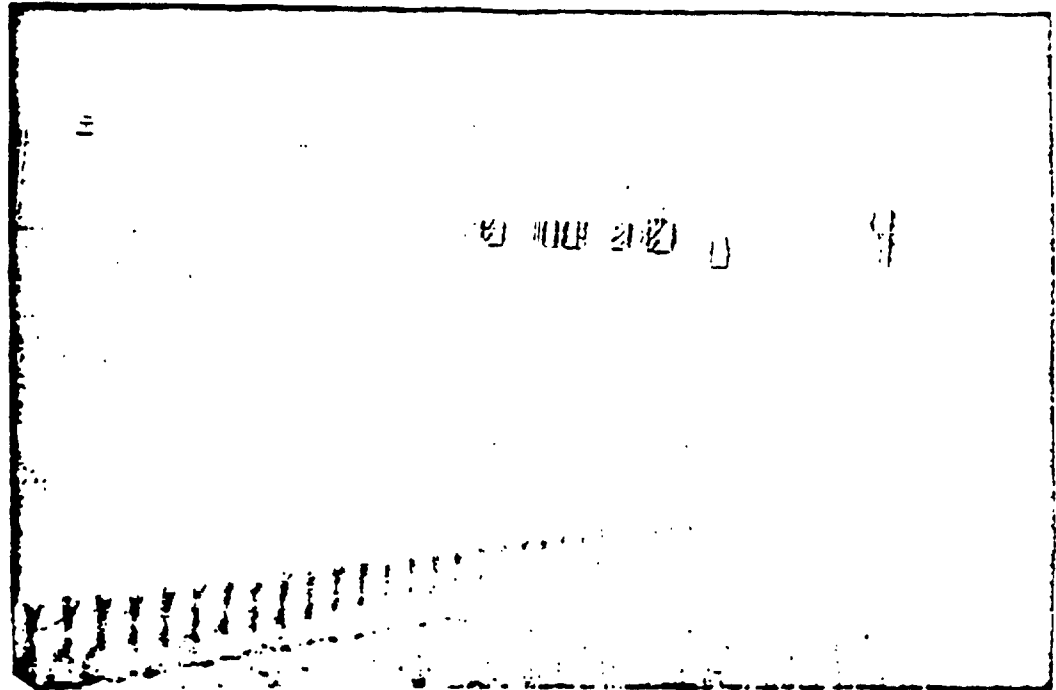
Main spinning and some spooling operations are carried on here. The department is provided with the Carrier System. No ring frame spinning is done.

TABLE No. 4

SPINNING

Sample No.	Building No.	Dept. No.	Location of Sample	Total Counts of Dust Particles per cubic foot	Weight of Dust in milligrams per cubic foot
52	1 2nd floor	4	Between mules 405 and 408 at S.E. corner of room	2,514,814	.49
53	1 2nd floor	4	Between mules 405 and 408 at the N.E. corner of room	4,576,610	.40
54	1 2nd floor	4	At the end of spooler 457	1,254,184	—

These counts are comparatively low and indicate effective control.



Mole Spinning

CARDING ROOM:

This room consists of two connecting departments occupying the second floors of building No. 1 and No. 3, except for a portion in building No. 1 devoted to spinning.

The section located in building No. 1 is equipped with the Carrier System. No form of humidification is used in building No. 3.

The carding machines in building No. 1 are totally enclosed by canvas covered wooden frames and each enclosure is equipped with an exhaust to remove the dust. That section located in building No. 3 is not totally enclosed. The exhaust on these machines is connected with the hood covering the comb of the card.

TABLE No. 5

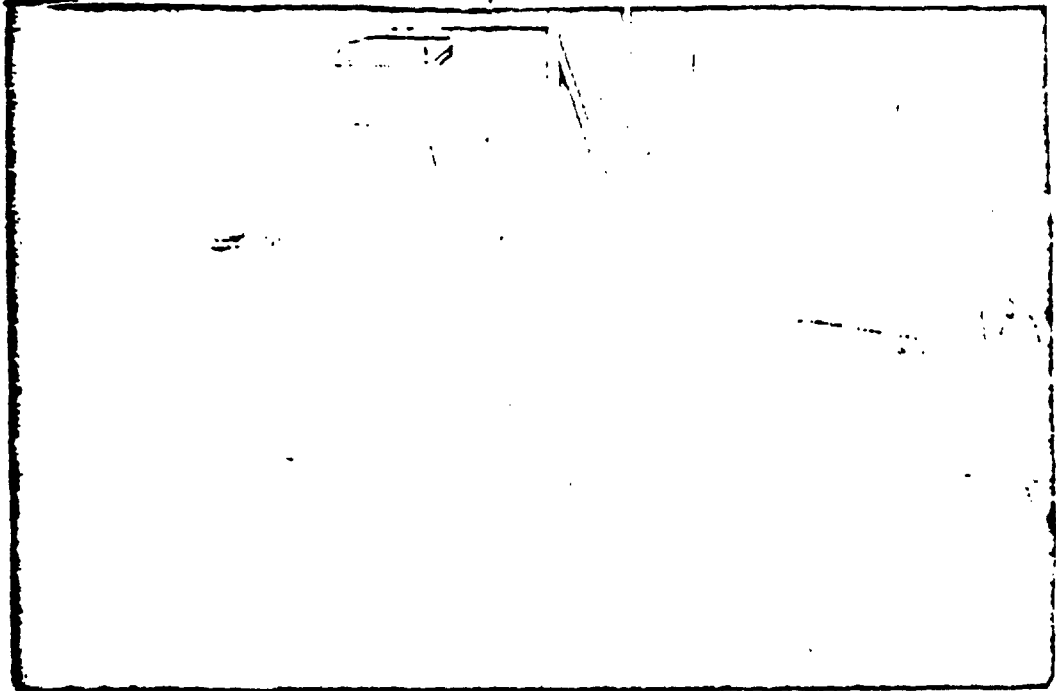
CARD ROOM

Sample No.	Building No.	Dept. No.	Location of Sample	Total Counts of Dust Particles per cubic foot	Weight of Dust in milligrams per cubic foot
36	1 2nd floor	2	Between cards #101 and 102	10,127,514	1.58
37	1 2nd floor	2	Alongside of card #201	5,519,228	.70
38	1 2nd floor	2	On spooler #459	5,625,518	.99
39	5 2nd floor	5	Alongside card #184	7,520,930	1.28
40	5 2nd floor	5	Alongside card #172	15,677,052	1.55
41	5 2nd floor	5	Between carders #162 and 193	6,221,064	.57

It will be noticed that the counts vary considerably and in two instances are quite high. No marked difference is noticed where the machines are totally enclosed and only partially enclosed.

14-1

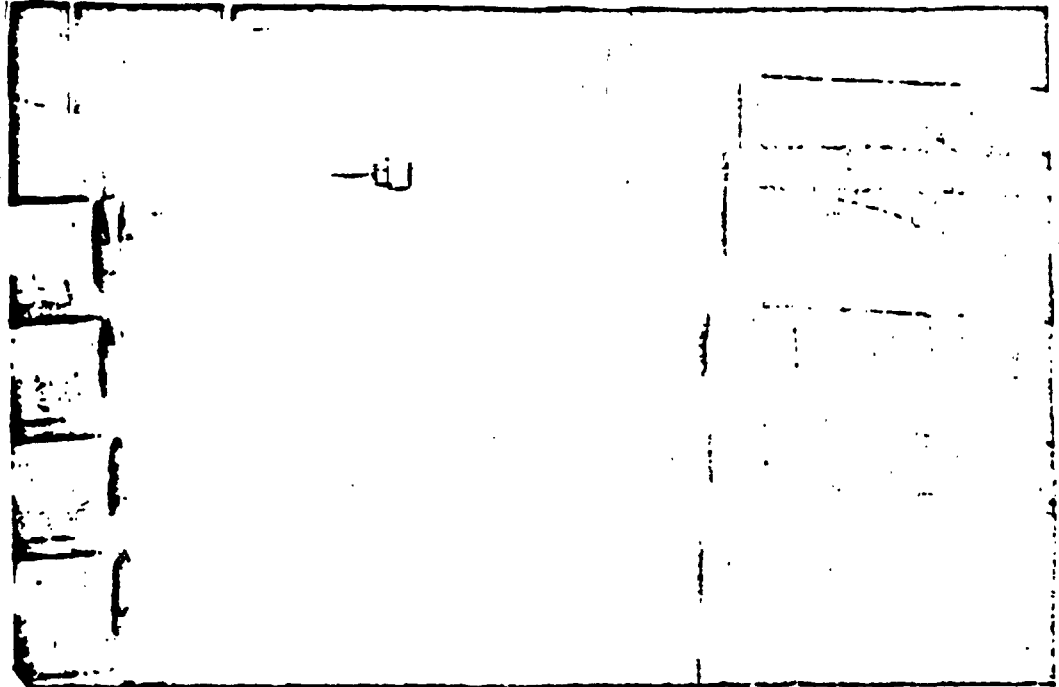
14-1



Main Card Room, Second Floor
Bldg. #1
Showing totally enclosed card machine

14-✓

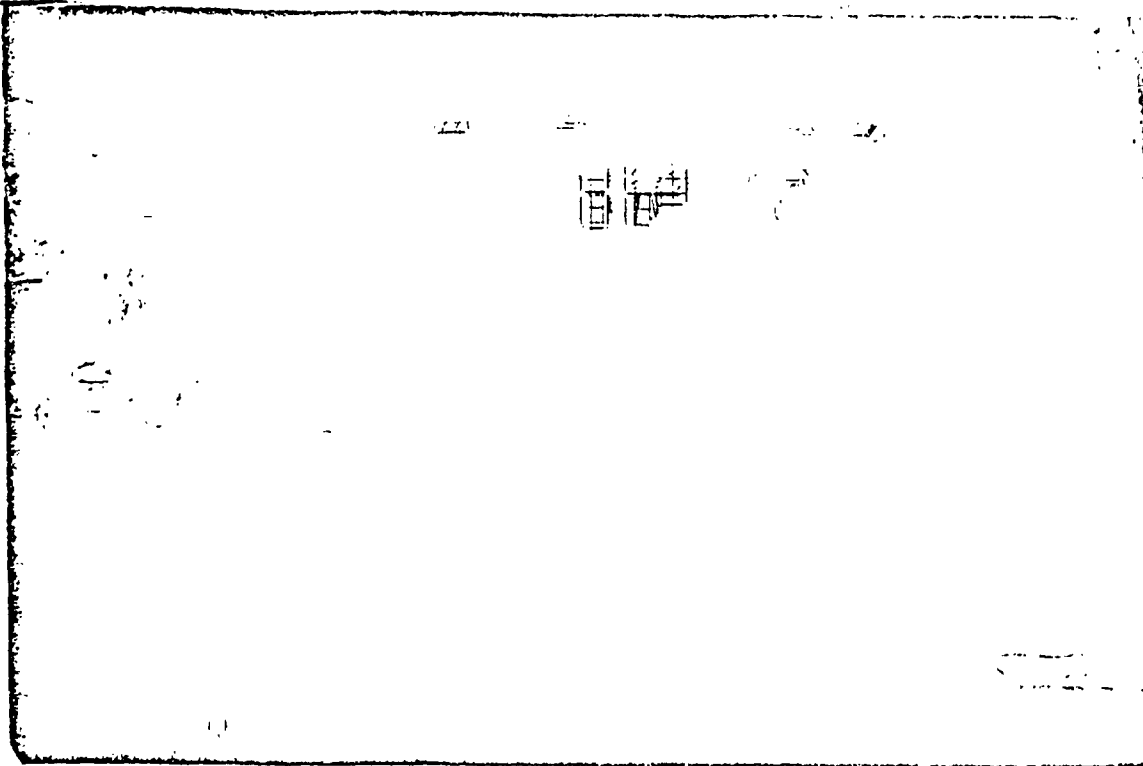
14-✓



Card Room, Second Floor
Blck. #1

14-3

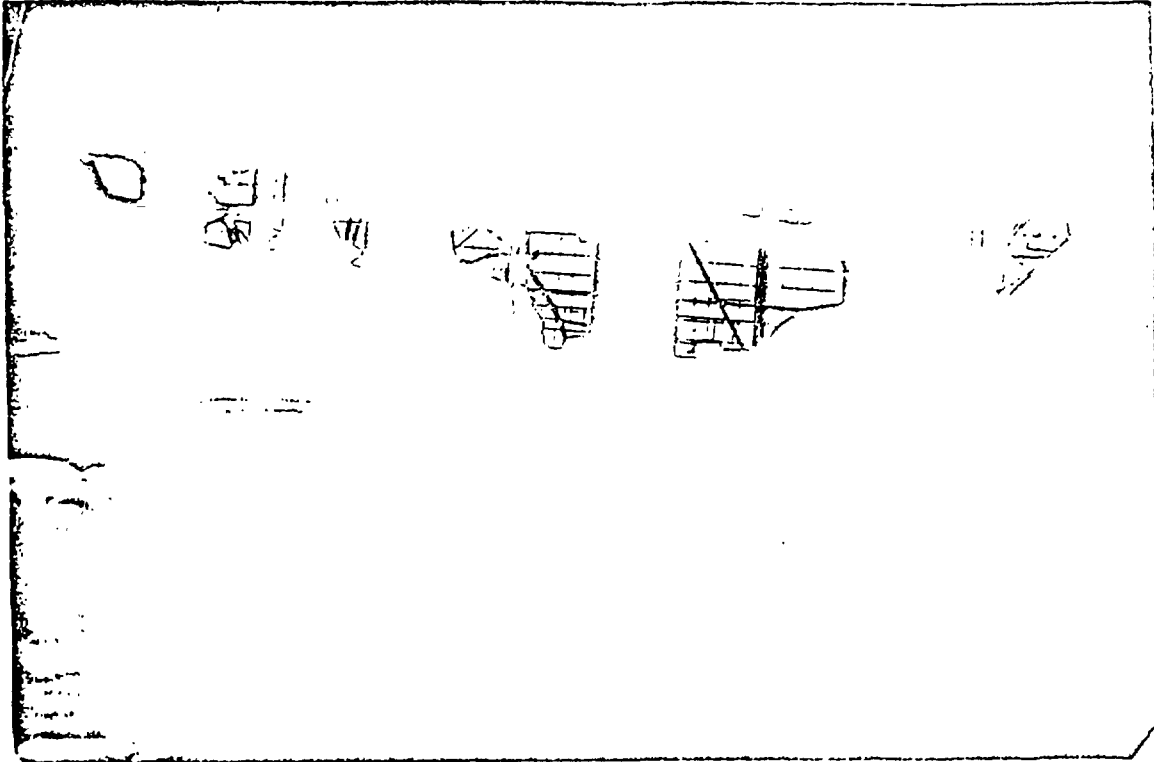
14-3



Card Room, Second Floor
Building #3

14-4

14-4



Card Room, Second Floor
Building #3

3

PLANT HOUSEKEEPING:

The floors are dry swept almost continuously throughout the working period. Each Friday the dust is removed from the ceilings, walls, and machines by means of an air hose during the working period. The dust counts during this period of cleaning would be increased considerably. It is recommended that cleaning be accomplished by means of a vacuum system. There are portable units on the market designed for this kind of work.

PHYSICAL EXAMINATIONS:

Physical examinations were made on fifty-four employees. All who worked in an asbestos industry three years or longer were included in this group. These employees were examined for symptoms usually associated with what English authorities term "asbestosis". These include anorexia, leaden hued complexion, emaciation, dyspnoea, cyanosis, cough, expectoration, "asbestos corns", decrease in chest expansion, clubbing of fingers, swelling of skin at the nails, and history of chest trouble. The chests of these employees were then examined for friction rubs, râles, dullness, diminished breath sounds, increased voice sounds, and where the symptoms and findings suggested further examination, X-ray pictures of the lungs were taken.

X-ray examinations were made of 20 employees; of these 10 showed definite evidence of asbestos dust injury to the lungs; one showed tuberculosis without dust injury, and nine were negative.

The action of inorganic dust upon the lung tissue is such as to cause the development of fibrous tissue - fibrosis. Such dust fibroses are classified under the general term pneumoconiosis. The various types of pneumo-

coniosis are further differentiated by more specific titles which define themselves, such as silicosis, anthracosis, and asbestosis.

On page 2 of the first unit report of this series of studies it was stated, in relation to the action of asbestos dust on the lungs, "We are confronted with three alternatives:

- (1) Asbestos dust does not cause pulmonary damage.
- (2) Asbestos dust does cause pulmonary damage akin to silicosis, but of a milder nature.
- (3) Asbestos dust itself does cause pulmonary damage, but in a manner and of a type entirely distinct from silicosis."

The X-ray films of this study definitely inform us that individuals exposed to the inhalation of asbestos will in time show structural changes in their lungs - pneumoconiosis. Our studies have not progressed sufficiently for us to construe this type of pneumoconiosis in term of disability or of increased susceptibility to tuberculosis. This type of pneumoconiosis, to which the term asbestosis may properly be applied, is quite distinct in its X-ray film appearance from true silicosis and an experienced technician would have no difficulty in distinguishing the two conditions. The evidence so far would indicate that the action of asbestos dust is in accord with the second alternative quoted above.

Four films showing definite asbestosis also showed old tuberculous lesions, apparently inactive, 3 of the films negative for asbestosis also showed such lesions; this would lend support to the contention that asbestosis does not tend to activate quiescent tuberculous lesions which is in accord with the meagre evidence so far available from animal experimentation and with the limited clinical experience.

The following table summarizes the X-ray examinations.

<u>No.</u>	<u>Sex</u>	<u>Age</u>	<u>Occupational History</u>	<u>Diagnosis</u>
1	F	55	Weaving 21 yrs. off & on, 4 yrs. U.S. Asbestos Co.	Negative
2	F	57	Twisting 15 years	Late first degree asbestosis
3	M	52	Weaving 12 years	Early first degree asb. old tubercu- lous lesion
4	M	53	Spooling 6 years	Negative
5	M	47	Spooling 5 yrs. U.S.As.Co. 14 yrs. elsewhere	Negative
6	M	68	Warping 12 years	Negative; old tuberculous lesion
7	M	50	Weaving 10 years	Early first degree asbestosis
8	M	44	Carding 5 years	Early first degree asbestosis; heart lesion
9	M	58	Spooling 5 years	Beginning asbes- tosis
10	M	37	Weaving 6 years	Negative
11	M	32	Weaving 9 years	Negative. Old tuberculous lesion
12	M	38	Weaving 22 years	First degree as- bestosis. Old tuberculous lesion
13	M	45	Weaving 7 years U.S. As. Co. 11 yrs. elsewhere off & on	Negative
14	M	64	Warping 12 years	Negative

<u>No.</u>	<u>Sex</u>	<u>Age</u>	<u>Occupational History</u>	<u>Diagnosis</u>
15	M	39	Weaving 5 years	Negative. Old tubercu- lous lesion active(?)
16	M.	52	Weaving 18 years	Early asbestosis
17	F	41	Spinning 5 years	Negative
18	M	33	Carding 7 years	First degree asbes- tosis
19	M	43	Foreman 22 years	Early second degree asbestosis
20	M		Worked in asbestos 20 years, out of plant 10 years	Late second degree asbestosis. Old tuberculous lesion

and extended wherever possible.

3. The dust counts indicate little difference between the two systems of exhausting dust arising from the carding machines. The canvas covers have no advantage in exhausting the dust, and have the disadvantage of making it more difficult to clean the machines. They also offer a larger surface for dust to settle. The exhaust system connected with the metal hood covering the comb of the card is recommended.

4. That the exhaust system attached to the machines in the preparation room be repaired and maintained, especially those connected with the shaker sieve and the wick carding machines.

5. That cleaning be done by means of a vacuum system instead of the present method of blowing with compressed air.

6. That all employees be given an initial physical examination and periodically thereafter. X-ray examinations should be made when indicated.

In the foregoing cases the length of exposure with the resultant degree of pneumoconiosis and the general appearance of the films all support the second alternative mentioned above.

Sputum analysis was made of ten of the individuals X-rayed, and "asbestos bodies" were found in one case.

SUMMARY:

Dust counts in the preparation room and carding room were high, several counts higher than ten million.

Individuals exposed to this dust showed definite pneumoconiosis. Their occupation and length of exposure were as follows (omitting 19 and 20 whose histories were not clear):

<u>Twisting</u>	<u>Spooling</u>	<u>Carding</u>	<u>Weaving</u>
15 years	5 years	5 years	10 years
		7 "	12 "
			18 "
			22 "

The number of these cases is too small to draw any final conclusions. They indicate a possible variation of hazard in the four processes listed, but further study will be needed to establish the facts.

RECOMMENDATIONS:

1. The method of application of the oil used in the preparation room at the Charleston plant is more effective than that used at Manheim. Therefore, the Charleston method is preferred.

2. That the humidification and air conditioning system be continued

Box 11

PM 2-346
MF
4/19/79

U.S. ASBESTOS & RUBBER DIVISION OF EGYPTIAN-AMERICAN, INC.

Asbestos, Pa.

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A second survey of dust conditions in the Asbestos plant of the U.S. Asbestos & Rubber Division of Egyptian-American, Inc. was made on April 16, 17, 18, 23, and 24, 1939. This is supplementary to the survey conducted in February, 1939 and the methods of sampling and analysis are the same as in the first survey.

The first survey included only those departments involving textile operations, whereas this survey includes all departments of the plant.

The processes in the Preparation Department, Carding Department, Brake Band Weave Room, and twisting, spinning, spooling, and broad cloth weaving departments are the same as at the time of the first survey. The exhaust equipment has not been changed.

The following tables show results of dust counts and comparative data of the two surveys:

U.S. ASBESTOS & RUBBER DIVISION OF RAYBESTOS-MANHATTAN, INC.

Manhata, Pa.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
<u>PREPARATION DEPARTMENT, DEPT. A1</u>							
1	Beside discharge pipe from vertical opener discharging fibre onto screen	4/16/35	20.0	6.2	5.15	Asbestos cotton	Stock 221 116 special
2	At loam #39 - wet tarp	"	27.9	20.9	17.4	"	Only loam in Prep. Dept.
3	Between chasers #1 and #2	"	13.0	21.8	18.1	Asbestos	Shobani fibre #2, one man
4	Beside trunk under discharge pipe from hopper on second floor	"	9.5	33.7	28.0	Asbestos cotton	One man, clothes covered with fibre
5	Floor mixing of asbestos and cotton between chasers and vertical opener	"	15.0	30.4	25.2	"	Three men
6	At discharge end of small fibre opener	"	20.5	10.2	8.5	Asbestos	Conveyor belt; one man, fibre from crusher
7	General air in preparation room	"	22.0	14.2	11.8	Asbestos cotton	Center of room
8	At hopper of mixing picker	"	15.0	21.8	18.1	"	One man, forking mixture into hopper from floor

Relative humidity in Preparation Dept. (1935) 20% - - (1930) 37%
 The average of these counts is 19.9 million particles per cu. ft. air sampled.
 The average count in this department in 1930 was 14.13 million particles per cu. ft. air.
 The analysis of raffia dust from this department showed 36% SiO₂.
 Relative humidity outside (1935) 50% - - (1930) 67%.

Sample No.	Station	Date of Sampling	Cu. Ft. of Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
CARD ROOMS							
9	At take-off end of breaker card #1, Dept. 2, 2nd floor	4/16/35	41.0	9.0	7.7	Asbestos cotton	
10	Taken between cards #9 and #16, Dept. 2, 2nd floor	"	20.5	13.7	11.7	"	129 mix - cards enclosed and exhausted
11	Between storage bins and cards #31 and #32 at operator's positions	"	31.1	18.8	16.0	"	Cards partially exhausted but not enclosed #32 - 130 stock #31 - 116 special
22	Same location as #11 just after stock from mixing picker had been blown into storage bins	4/17/35	36.5	16.2	13.8	"	Bin door opens on this floor
12	Between cards #1 and 2 and #7 and 8 operator's station, Dept. 3, second floor, 3 cards running 224 stock; 1 card running 124 stock	4/16/35	22.5	16.7	14.2	"	Cards partially enclosed and exhausted; operator wore gauze strip with cotton pad under nose.
13	Between cards #7 and #8 on saddle side; saddles extend out from enclosure	"	10.0	36.8	31.4	"	Dept. #3, second floor
14	Between cards #18 and 19 and #25 and 26 in aisle where operator works	"	20.0	28.4	24.2	"	Cards partially enclosed and exhausted; 3 cards running 224 stock 1 card running 60/40 stock
19	Between cards #20 and 21 and #27 and 28 in aisle where operator works; cards partially enclosed and exhausted	4/17/35	30.0	8.8	7.5	"	2 cards running 60/40 stock; 1 card running 231 stock; 1 card running 224 stock

Relative humidity 28%.

The average of these counts is 18.55 million particles per cu. ft. air sampled.
The average count in these departments in 1930 was 7.78 million particles per cu. ft. air sampled.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
SPINNING DEPT. #4, 2nd floor							
15	Between speeders twisting wire and yarn, 2 men	4/16/35	20.0	20.0	17.0	Asbestos cotton	Machines #464 463, 462, 459 229 stock - 224 stock
16	Between mules #417 and 402 where operators work	"	27.5	29.6	25.2	"	"
17	Between mules #404 and 405 where operators work	"	20.0	12.4	10.5	"	"
18	Between mules #406 and 407 where operator works	"	20.0	17.6	15.0	"	"

Relative humidity 28%.
 The average of these counts is 19.9 million particles per cu. ft. air sampled.
 The average count in this department in 1930 was 2.72 million particles per cu. ft. air sampled

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
WEAVE ROOM (BRAKE BAND) DEPT. #12							
20	Between looms #3 and #23 dry weaving	4/17/35	30.0	14.9	12.7	Asbestos cotton	Ring stock and brake lining 224 stock one man
23	At operator's position of loom #17	"	23.3	14.8	12.4	"	Pontiac brake lining 224 stock
24	In aisle between looms #33 and #19, wet weaving	"	32.5	8.85	7.5	"	#33 - 224 stock #19 - 310 stock
25	In aisle between looms #14 and #26, and #7 and #12	"	23.0	7.3	6.2	"	#14 and #26 - truck lining - wet #7 and 12 dry - 224 stock
26	Inspection of brake lining and ring stock	"	30.0	6.15	5.2	"	Material goes thru revolving brushes - exhaust system

Relative humidity (1935) 47% - (1930) 76%
The average of these counts is 10.4 million particles per cu. ft. air sampled.
The average count in this department in 1930 was 6.9% million particles per cu. ft. air.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
SPOOLING, TWISTING & REWINDING							
27	Between looms #1 and 2 and #3 and 4; broad looms, #1 not running	4/17/35	49.0	8.8	7.55	Asbestos cotton	Air-water spray for humidifying, Dept. 10.
28	At looms #22 and 24, cloth	"	26.0	16.3	14.0	Asbestos cotton	#24 warp wet with a hose; #22 dry.
29	At loom #10 - wet weaving, 890 cloth, 3 ply for clutch facing	"	22.0	10.3	8.8	"	210 - 224 air, warp passes through 634 emulsion
30	Between tristers #657 and 658	"	24.0	13.7	11.6	"	2 women, dept. 7.
31	Between tristers	"	26.6	18.0	15.4	"	2 women, dept. 7.
32	Between spoolers #3 and 4, dept. 6	"	20.8	25.0	21.4	"	6 women, dust on machines blown off with cardboard used as fans.

Relative humidity (1935) 41% - - (1930) 50%
The average of these counts is 15.35 million particles per cu. ft. air sampled.
The average count in this dept. in 1930 was 2.35 million particles per cu. ft. air sampled.

CONCLUSIONS AND RECOMMENDATIONS

TEXTILE DEPARTMENT

The dust counts in the Preparation Department are high. All counts, but one, show more than ten million particles per cubic foot. The raw fibre is handled carelessly and piled on the floor at various places. The average dust counts are higher than those of the survey made in 1930. No improvements have been made since the first survey was made. The relative humidity is lower than at the time of the previous survey. x

It is recommended that a mechanical method of handling the fibre be installed. Exhaust equipment, properly designed and applied, be installed at the chasers, pickers, and shaker screens and it should be properly maintained. The one loom should be removed from this department. A humidifying system should be used, if practicable. A vacuum sweeping system for sweeping and cleaning machines should be installed throughout the plant.

The average counts in the brake band waste room are higher than those of the 1930 survey. No exhaust equipment is in use on the looms. The relative humidity is lower than at the time of the first survey.

It is recommended that wet work be done whenever possible. The humidity should be kept as high as possible without causing discomfort to the workmen.

The average dust counts in the spinning, twisting, and weaving departments are much higher than those of the first survey. The relative humidity is lower than at the time of the first survey.

It is recommended that the broad looms be exhausted and the humidity be kept higher.

The average dust counts in the spinning department are much higher than those of the first survey. This may be attributed to pollution of the air from the carding machines located in the same room and to the low humidity. A check of the records will show the grade of fibre used at the time of the two surveys and the rate of production.

It is recommended that the spinning department be isolated from the carding department. A humidifying system should be installed.

The average dust counts in the carding departments are higher than those of the first survey. A check of the records would show the grade of fibre used at the time of the two surveys and the rate of production. The exhaust equipment does not seem to be effective in removing the dust generated.

It is recommended that exhaust equipment, similar to that in operation at the Charleston plant, be installed on the carding machines. Fibre storage bins opening into the card room should be exhausted.

BRAKE LINING AND CLUTCH FACING

PROCESSING

The types of brake lining are made. One type is made from seven narrow bands of asbestos. The bands are saturated in an emulsion or a rubber solution according to specifications. They are cured in heated presses or on heated mandrels. If they are cured on heated mandrels, they are cut to length before being cured. The mandrels also shape them into arcs. They are ground to the thickness desired and rivet holes are drilled or punched into them. They are inspected and packed for shipment.

The second type of brake lining is the extruded type. This type is produced from a mixture of asbestos fibre, litharge, sulphur, zinc oxide, whiting, zinc, and rubber dissolved in gasoline. This wet mixture is put into an hydraulic press and is extruded through a die into long narrow strips. The strips are cured in heated presses. They are ground to the thickness and width desired and formed on heated mandrels. Holes for rivets are drilled or punched into them. The ends are chamfered. The lining is then inspected and packed for shipment.

Clutch facing is made from asbestos cloth and narrow bands of woven asbestos. The wide cloth is cut into squares on a band saw. Solid rings are cut from these squares after they have been saturated in an emulsion and dried. The rings are cured in heated presses. They are then ground to the thickness desired. Holes are drilled into them on gang drill presses. The inside and outside diameters are ground on Gariner grinders. The clutch facing is then inspected before shipping.

The narrow bands of woven asbestos are put through a sewing machine to be formed into spirals. These are then put through a rubber solution and wound onto a mandrel. The rings are cut and the ends fastened together with brass wire. They are cured in heated presses and ground to the dimensions required. They are then inspected before shipping.

ROADED GASKETS AND PACKING

Asbestos cloth is impregnated with a solution of rubber and gasoline. The cloth is then cut into strips. The strips are folded by hand roughly to form the gasket or packing. The rough forms are then placed in forming molds and pressed and cured in steam heated presses. The edges are trimmed and the product is then inspected.

Rubber used in the various products is compounded in building #2. The raw rubber is mixed with zinc oxide, lithopone and barytes in a rubber compounding mill. The compounded rubber is dissolved in gasoline in tumbling barrels.

The emulsions used in the various products are made in building #35. The materials used are litharge, lampblack, mica, Gilsomite, linseed oil, kerosene, and water. These materials are weighed and put into an electric mixer. After the emulsion is mixed, it is put into pails and carried to the different departments where it is used.

ANALYSES OF BLOOD SPECIMENS

Name	Age	Occupation	Years of Exposure	Hemoglobin %	Punctate Eosinophiles	Remarks
Lee F. Blanch		Emulsion preparation	2	50	Frequent	Poor teeth
Harry L. Bullock		Grinding brake lining	5 (approx.)	88	Negative	
Samuel Wright		Mixing for extruded brake lining	1½	65	"	Stomach trouble
Charles Matreass		Cutting brake bands	6½	40	Occasional	Formerly mixing for extruded brake lining, changed because of sick- ness, had lead poisoning 2 years ago, treated by doctor
LeRoy Galt	26	Ball grinder	1½	94	Negative	Complains of nervous disorders and stomach trouble, claims to have high blood pressure
Robert Guider	22	Extruder	3	60	"	
Louise Winger	20	Label and stamp segments	1½	70	"	
Mark Mohr	26	Segment grinder	2½	85	"	
E. F. Walter	40	Dept. of welded brake lining dept.	4½	55	"	
Olive Bauer	22	Label and stamp segments	1 1/3	70	"	
Annette Shanks	23	Label, stamp and chip segments	1 1/3	80	"	
Malcolm Shaffer	23	Brailer	1	65	"	
E. Spensler	20	Handrole	2	95	"	
John Miller	29	Rubber mixer	1½	97	"	
Ever Miller	30	Segment grinder	6 yrs.	90	"	Worked 10 years previous- ly as silk weaver
Paul S. Hallinger	25	Supervisor of welded brake lining	1	100	"	

CONCLUSIONS AND RECOMMENDATIONS

CLAYTON FACTORY, BRAKE LINING AND PACKING DEPARTMENTS

Several dust counts in these departments are high and in almost all cases show that there is lead present in the air. Samples #14, 15, 16 and 17 show large quantities of lead present. Chemical analyses of rubber dust samples from these departments also show presence of lead. These analyses show that there is a definite health hazard present due to the use of lead. There is another health hazard present due to the use of benzol in the treating of brake bands.

Blood specimens were taken from sixteen employees and the results of these tests are shown in tabular form. Only two specimens showed polystate leucophiles (stippled cells), but several other specimens showed low hemoglobin percentage.

It is recommended that a vacuum sweeping system be installed to do away with dry sweeping.

All machines in these departments should be equipped with efficient exhaust systems to carry away harmful dusts.

Employees engaged in handling lead should be supplied with positive pressure or cartridge type respirators and cautioned to handle the lead carefully. These operations should be isolated from the remainder of the departments. Female help work in the same room in which litharge is mixed for extruded brake lining. Empty litharge drums should be removed from the department.

The use of benzol should be eliminated, if practicable, or such operations should be isolated so that the least number of employees would be exposed to the fumes, or the benzol could be handled in a closed system.

The employees exposed to benzal fumes should be supplied with positive pressure respirators. All employees in these departments should be watched carefully and examined periodically for signs of lead or benzal poisoning.

Sample No.	Section	Date of Sampling	Gr. Fl. Air Sampled	Millions of Particles per Gr. Fl. Air Sampled	Millions of Particles, Less Than 10 Microns in Greatest Diameter per Gr. Fl. Air Sampled	Milligrams of Lead per Gr. Fl.	Milligrams of Lead as Pb. Sulfate	Lead Levels in Milligrams per 100-Gr. Fat	Type of Diet	Remarks
SECTION 1: LITHARGE AND SHALE LITHARGE										
77	General air - locomotive of house (1000), Dept. 77.	1/14/38	14.0	0.40	0.0	0.0017	0.0011	0.111	Litharge rubber	1 can - 2 ms
78	At outside grinder, Dept. 77, house lining	"	25.0	0.4	0.15	0.0001	0.000	0.00	"	Litharge system
79	General air, working and working area on house lining, Dept. 77	"	20.0	1.2	12.0	0.0017	0.0011	0.111	"	Household materials - 1 ms
80	At inside grinder, house lining, Dept. 77	"	25.0	10.0	10.0	0.015	0.021	0.21	"	Litharge system
81	At grinder (277) and (277), asbestos house lining, Dept. 77	"	27.0	0.1	0.7	0.0001	0.000	0.000	"	Litharge system
82	Bagging materials for asbestos house lining, Dept. 77	"	15.0	15.0	15.0	0.0017	0.000	0.00	Litharge also asbestos	These safety appliances respirator were only while handling litharge can also, rubber stored in position.
83	At house and cutting asbestos cloth for clutch fittings, cloth and rubber lining located	"	10.0	0.0	10.0	-	-	-	Asbestos asbestos	1 ms while cutting rolls 1 ms wear respirator, Dept. 77
84	General air - house near house area for during house lining, Dept. 77	"	17.0	10.0	0.0	0.0001	0.000	0.00	Asbestos rubber	
85	At outside grinder (77) asbestos grinder, Dept. 77	"	25.0	7.0	0.0	0.0017	0.000	0.00	Asbestos litharge rubber	1 ms - asbestos system
86	General air - house at house process during clutch fitting	"	20.0	0.0	0.7	0.000	0.000	0.000	"	3 ms - Dept. 77
87	At inside grinder (77), clutch fitting, Dept. 77	"	20.0	10.0	10.0	0.0011	0.000	0.00	"	1 ms - asbestos system
88	Same as sample 81 1/15/38	1/15/38	25.0	10.0	0.0	0.0001	0.000	0.000	"	
89	Litharge grinder (77) Dept. 77 at operator's position	"	20.0	10.0	0.0	0.0017	0.000	0.000	"	Litharge system - 1 ms cloth fitting
90	Roll (77), Dept. 77, cutting later in clutch fitting	"	20.0	0.0	0.0	0.0011	0.000	0.000	"	1 ms - asbestos system
91	Grinder grinder (77), Dept. 77, grinding clutch fitting, asbestos system	"	20.0	10.0	10.0	0.0011	0.000	0.00	"	Large particles thrown off - up rubber near engine
92	General air - clutch fitting inspection Dept. 77	"	20.0	7.0	0.0	0.0001	0.000	0.00	"	6 ms - 4 ms
93	Trying asbestos cloth (77)	"	10.0	0.0	0.0	-	-	-	Asbestos asbestos	1 ms - not run to rubber old road
94	General air, rubber grinding Dept. 77, 1/15/38	1/15/38	27.0	20.0	20.0	0.000	0.000	0.000	Asbestos	1 ms - position on animal
95	At rubber mill, (77)	"	20.0	20.0	20.0	0.000	0.000	0.000	Litharge asbestos litharge asbestos	1 ms - no respirator
96	General air - between inspection of cloth and working cloth for grinder, (77)	"	20.0	0.0	0.0	-	-	-		
97	Grinder Dept. 77, fitting grinder over rubber (77)	"	20.0	7.0	0.0	-	-	-	Asbestos	4 ms
98	General air, grinder Dept. 77, fitting grinder (77) rubber (77) asbestos cloth	"	20.0	10.0	0.0	-	-	-	Asbestos rubber inspection	10 g/l
99	Grinding machine, (77) 7/2 ms, no asbestos, no respirator	"	20.0	77.0	20.0	0.0007	0.001	0.00	Litharge inspection also	Litharge hand assembly: lined oil, asbestos, water

General analysis of air and samples
 One above for organic waste listing
 Department 77 - - - 0.000 lead
 One rubber (77) - 0.000
 Analysis Department - - - 0.000

HEALTH HAZARDS OF ASBESTOS AND OTHER DUSTS

Asbestos dust gives rise to a pneumoconiosis or fibrosis of the lungs which has been discussed in the previous report made on the asbestos industry. Developments in our knowledge of asbestosis are continually taking place and a summary of new facts discovered will be added to the general composite report of the asbestos plant survey which is to be brought out later.

Silica dust. Very little is known of the effect of silica dust on the lungs, but such evidence as there is would tend to place it in a class with the less harmful silicate dusts such as talc and clay. If inhaled in sufficiently high concentrations, these dusts would have to be considered potentially harmful, however, until the contrary is proved, although they apparently do not have the specific injurious effect of the dusts high in uncombined silica.

With the exception of litharge, or lead, an extremely toxic dust, the other dusts generated in the compounding of rubber and brake linings such as zinc oxide, sulphur, and lithopone are probably relatively harmless in the quantities present and in any event proper protection against the lead or litharge dust which is essential would protect against these also.

TOXICITY OF LEAD

Lead poisoning is probably the most common of the industrial poisonings. Practically all forms of lead are toxic, the degree of toxicity depending upon their solubility in human tissues. The oxides and basic lead carbonate are among the most soluble and therefore the most readily toxic forms.

Lead inhaled is more rapidly and more surely toxic than lead ingested. When lead enters the digestive tract some or most of it may be eliminated unchanged from the body and it is only when it is absorbed in greater quantities

then are eliminated that poisoning occurs. When lead is taken into the lungs, it reaches the blood stream rapidly and directly and comparatively little is eliminated. While lead is circulating in the body poisoning may occur. Lead absorbed in excess of lead eliminated is accumulated in various organs and is finally deposited in the bones in insoluble form in a manner similar to the deposition of calcium. It is somewhat controversial at the present time whether or not under ordinary circumstances changes in bodily metabolism can later render the lead thus stored in the bones soluble again and set it free into the circulation causing poisoning without further exposure. It has been demonstrated by Aub and his associates,⁽¹⁾ however, that this stored lead can be released by medication with weak acids and low calcium intake. Aub's studies on the subject eight or ten years ago revolutionized the treatment of lead poisoning. Extensive studies on lead poisoning have also been made recently by Kehoe and his associates⁽²⁾ who have made valuable contributions to the knowledge of the subject.

Lead absorption does not necessarily mean lead poisoning, but there is probability of lead poisoning wherever lead is being absorbed into the body. Individuals vary considerably in their ability to take in and eliminate lead. It is generally considered that negroes, women, and children are more highly susceptible and that those who have had attacks of poisoning are more liable to future attacks than those who have not.

With a few notable exceptions, industrial lead poisoning is of the chronic type due to prolonged exposure to minute quantities of lead taken in daily. Owing to the above-mentioned differences in the toxicity of lead compounds, in the paths of entrance into the body, and in individual susceptibility

(1) Aub, J.C., Fairhall, E.T., and others, Lead Poisoning, Medicine Monographs, Vol. VII, The Williams & Wilkins Co., 1925, Baltimore, Md.
 (2) Kehoe, E.A., Thomas, Fred, and Chalk, Jacob, Lead Absorption and Excretion in Certain Lead Trades, Journal of Industrial Hygiene, Sept. 1933, Vol. 14, No. 3, pp. 306-319, Balt. Md., another article pp. 323-340.

ity, there is little agreement in the numerous attempts that have been made to estimate the maximum amount of lead which can cause chronic poisoning if taken in over long periods of time. The various estimates range from one-tenth of a milligram to two milligrams daily. Probably one to two milligrams daily represents a fairly safe limit.

In a study made by the United States Public Health Service⁽³⁾ in a storage battery plant, for instance, it was concluded that for the conditions of exposure in that plant, 1.5 milligrams per 10 cubic meters of air appeared to be a safe limit.

It is also impossible to determine exactly the amount of air taken into the lungs daily, owing to individual differences and to differences in degree of activity. For practical purposes only, therefore, it is roughly estimated that a man at moderately heavy work inhales about 10 cubic meters of air in a ten-hour day. Where possible, it is recommended that the working atmosphere should be kept below one-tenth of a milligram per cubic meter of air or the workers should be protected by suitable respirators and other precautions. Removing lead at its source of origin is by far the best method for prevention of poisoning.

Evidence of lead absorption is shown by an ashen pallor of the skin, a lead line on the gums, stippling of the red blood cells, and a secondary anemia or other indication of damage to the blood-forming organs. Upon evidence of lead absorption workers should be removed from exposure until all signs have disappeared.

Lead exposed workers are under very careful and experienced medical control. It is possible to catch every case of poisoning in the absorption.
⁽³⁾U.S. Public Health Service, Treasury Dept., Public Health Bulletin No. 135, Lead Poisoning in a Storage Battery Plant, Gov. Print. Off. Wash. D.C., 1933.

stage or in the early stages of intoxication and, by taking appropriate measures, to prevent the occurrence of any acute or sub-acute attacks of poisoning. It is not easy, however, to diagnose lead in its early stages without laboratory studies of the blood, and there will generally be cases which will present symptoms unexpectedly and in an unusual manner.

The symptoms of lead poisoning are numerous and it manifests itself in a great variety of ways. The most common characteristic symptoms noted are colic, constipation, weakness, especially of the extensor muscles of the hands and feet, muscular pains, nausea and vomiting, loss of appetite, bad taste in the mouth, nervousness and irritability. The prominent objective signs of lead poisoning are pallor or jaundice, tremor, reflex changes, changes in the blood picture, excessive amount of lead in the excreta.

Lead intoxication brings in its train a great many sequelae, including paralysis, optic atrophy, encephalitis, and premature old age. It causes early degenerative changes such as arterio-sclerosis and nephritis. The mortality from chronic lead poisoning is not high, but this is absolutely no indication of the extent to which cases are occurring since cases treated early have a fairly good prognosis and since many deaths are recorded as due to the final sequelae such as arterio-sclerosis rather than to the original cause.

Among the measures for control of lead poisoning recommended by the industrial physician of a large rubber manufacturing plant in Akron, Ohio are (1) monthly medical examinations of exposed workers, (2) separate lockers for work and street clothing, (3) provision of two sets of work clothing and arrangements for laundering weekly, (4) two respirators, one of them to be cleaned and sterilized each day, (5) provision of clean towels, soap and nail brushes, hot

running water, and time allowance for thorough washing, (5) wet sprinkling and sweeping or vacuum cleaning of the floor daily, (7) exclusion of all other workers except those engaged in operating lead processes from the room, and (8) rules strictly enforced against eating in the workrooms.

TOXICITY OF BENZOL, ITS HOMOLOGUES, TOLUOL AND XYLOL, AND OF BENZOLIN
CINCHOLIN

Benzol is by far the most hazardous of the solvents commonly used in industry. It was at one time quite widely employed in many processes and especially in paints and lacquers used for coating by air guns, but because of its recognized danger to the health of operatives, its use has been largely supplanted by less toxic substances. The higher homologues of benzol such as toluol and xylol have been substituted in some cases with and in some cases without success from the health standpoint. These substances are more poisonous than benzol in high concentrations such as would result in acute accidents, and, experimentally, animals die in a shorter time and with lesser concentrations than is the case with benzol. However, their lower volatility gives toluol and xylol an advantage over benzol for industrial practice with respect to health of the workers and the effects of chronic poisoning; by toluol not containing any benzol now to be less serious and not so lasting.

The Benzol Committee of the National Safety Council⁽¹⁾ found that benzol would cause signs of poisoning at concentrations of only 100 parts per million in the atmosphere. Slight effects are possible with even for lower concentrations. It should be borne in mind that benzol can also be absorbed into the system through the skin and that it is extremely dangerous to spill it on the skin or clothing.

~~The committee of experts has selected the following as the most dangerous~~
⁽¹⁾National Safety Council, Final Report of the Committee on Benzol, Toluol and Xylol Section, Chicago, 1923, pp. 117-118.

over a period of time to low concentrations of benzol vapor are well known and consist of headache, dizziness, weakness, loss of appetite and weight, sore gums, shortness of breath, and, sometimes, abdominal pain, nausea and vomiting. The signs, with due allowance for atypical cases, generally consist of a marked reduction in the number of white blood cells, a changed relationship between the percent of polymorphonuclear cells and the lymphocytes, and later on pallor, due to aplastic anemia, oxygen want or internal asphyxiation, prolonged coagulation time, bleeding from the mucous membranes, purpura, and sometimes tremor and visual disturbances.

Besides the serious systemic effects, benzol, in common with many other solvents, may cause a dermatitis of the skin.

Individual susceptibility to poisoning by benzol appears marked. The fact that cases of poisoning are not being reported from workers in a given process is no guarantee of safety unless physical examinations with blood counts are carried out on employment and regularly during exposure. The symptoms are vague, the worker frequently is not aware of his exposure, and the family physician is usually not familiar with the manifestations of chronic benzol poisoning.

The National Safety Council committee has recommended that a 25% reduction in the white cell blood count should be considered as evidence of poisoning. The color index of the blood is not a reliable criterion, since destruction of red blood cells usually occurs fairly late in the picture after serious or fatal damage has been done to the blood forming organs. Other conditions may be present which could cause a picture somewhat similar to that of benzol poisoning, in which case detailed study and observation are indicated. (5)
~~(5)McCard, Harry F., M.D., The Present Status of Benzene (Benzol) Poisoning, Journal of the American Medical Association, July 27, 1929, pp. 260-263.~~

The National Safety Council committee found that 32% of the exposed workers who were examined in various factories had leukopenia (decreased white blood cells) in mild or pronounced degree even when benzal concentration in the air was low and exhaust ventilation was good.

Preventive measures in handling so dangerous a substance logically consist of completely enclosing processes or containers and in providing carefully designed downward-draft ventilation, the results of which should be checked by air sampling. The method of choice, however, is to substitute some other less harmful substance where possible.

TOXICITY OF GASOLINE AND KEROSENE

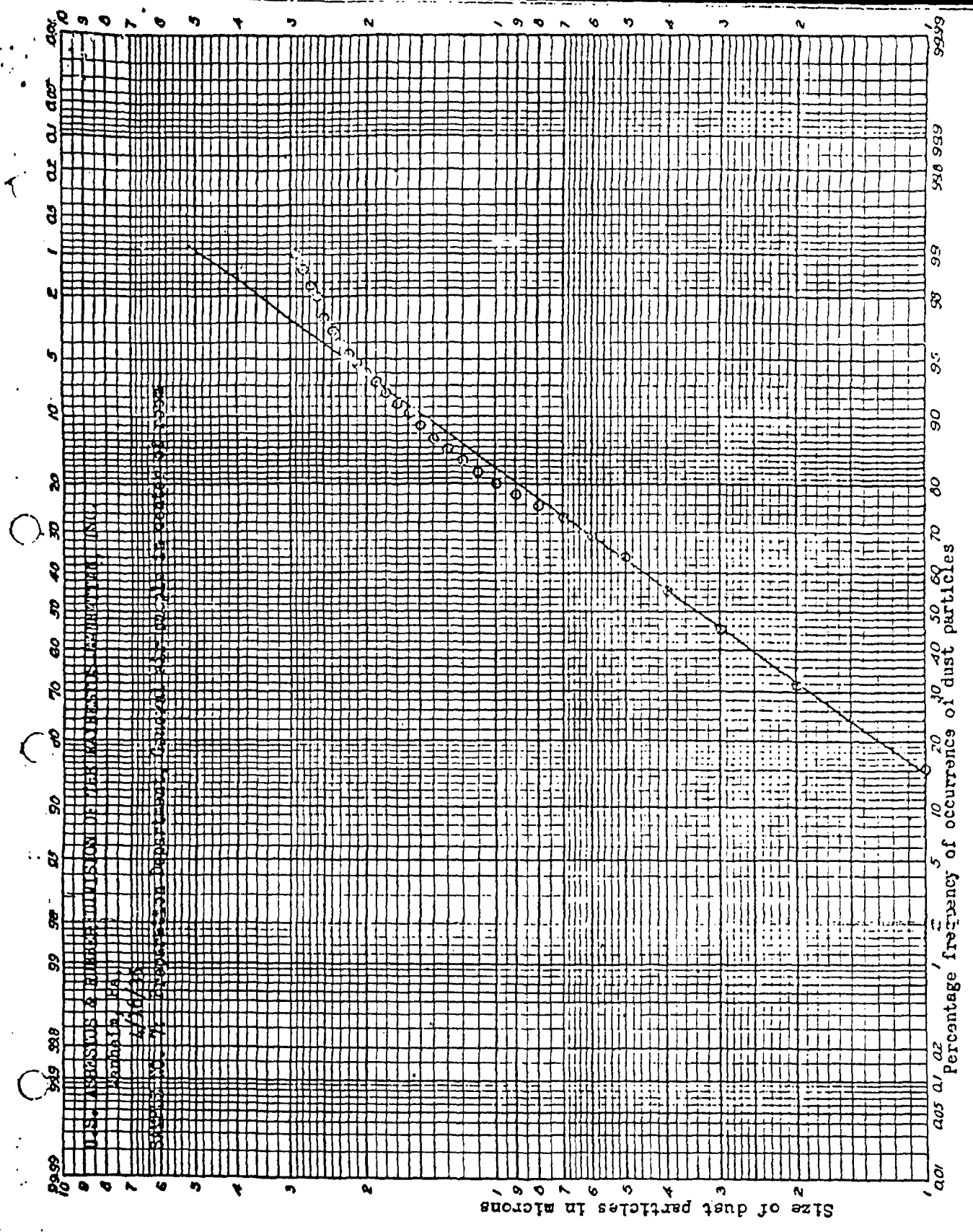
In the presence of heavy fumes from these petroleum solvents, an acute anesthetic poisoning occurs with headache, blurring of vision, mental confusion, dizziness, nausea, and loss of consciousness. Permissible maximum concentrations⁽⁶⁾ in the air breathed are estimated to be from 1000 to 3000 parts per million for short exposures and 1000 parts per million or less for prolonged exposure.

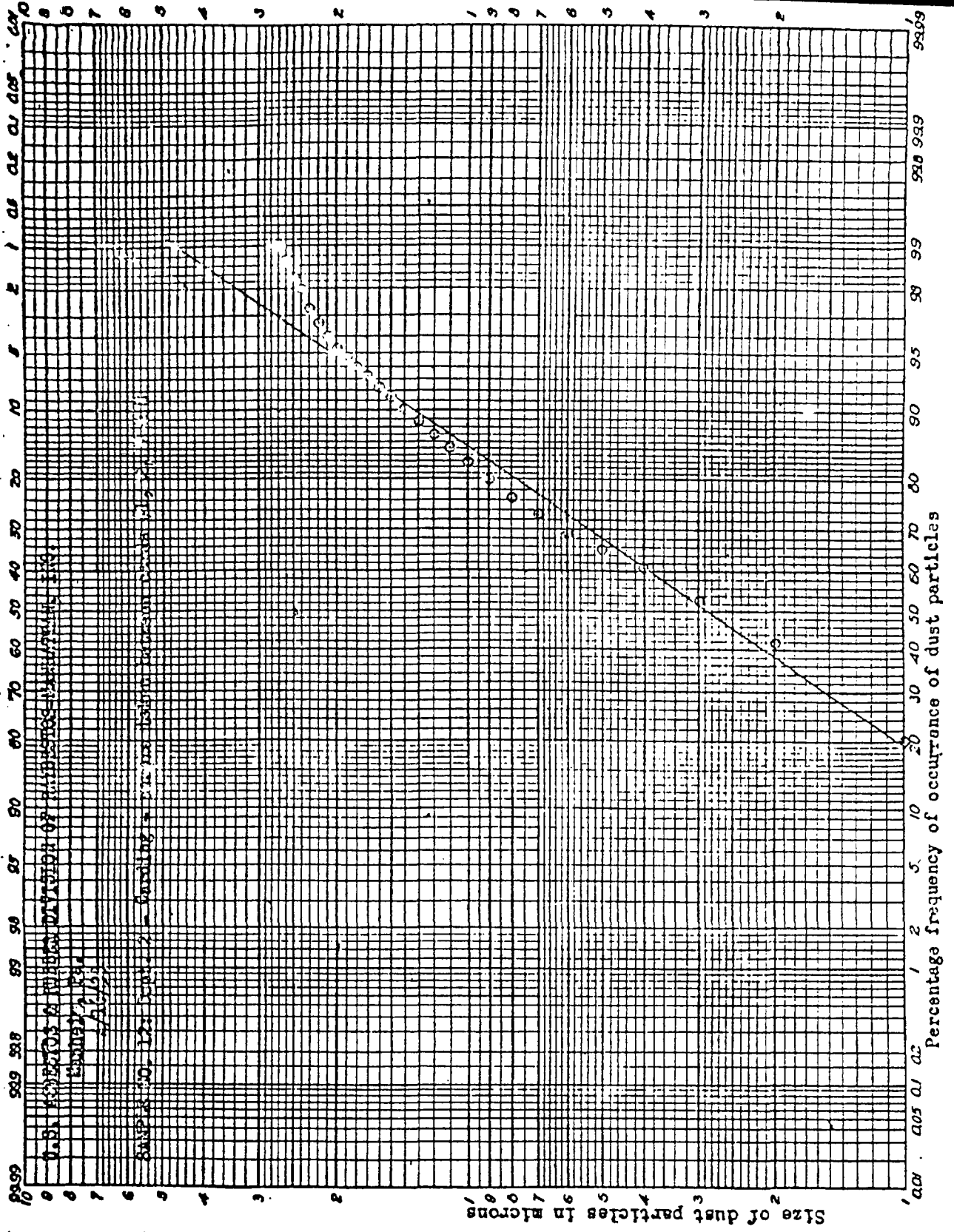
These substances are fat-solvent and skin trouble is frequently caused in those who come into continuous contact with them. Gloves are apt to aggravate the difficulty since without free evaporation, burns are caused by the gasoline getting inside the gloves. A booklet describing precautions to be taken against oil dermatitis is enclosed.

TOXICITY OF LINSEED OIL

In addition to the danger of spontaneous combustion, linseed oil, when heated gives off irritating fumes of acrolein which may be acutely toxic in concentrations of more than 30 parts per million of air, while for prolonged⁽⁶⁾ U.S. Bureau of Mines

exposures 3 parts per million is considered the maximum permissible by the United States Bureau of Mines. No chronic ill-effects have been noted from this substance as used in industry, though it is irritating to the eyes, nose and throat. In addition dermatitis or infections of the skin are common among workers handling these oils. Those showing hypersensitivity are best removed from contact with them.

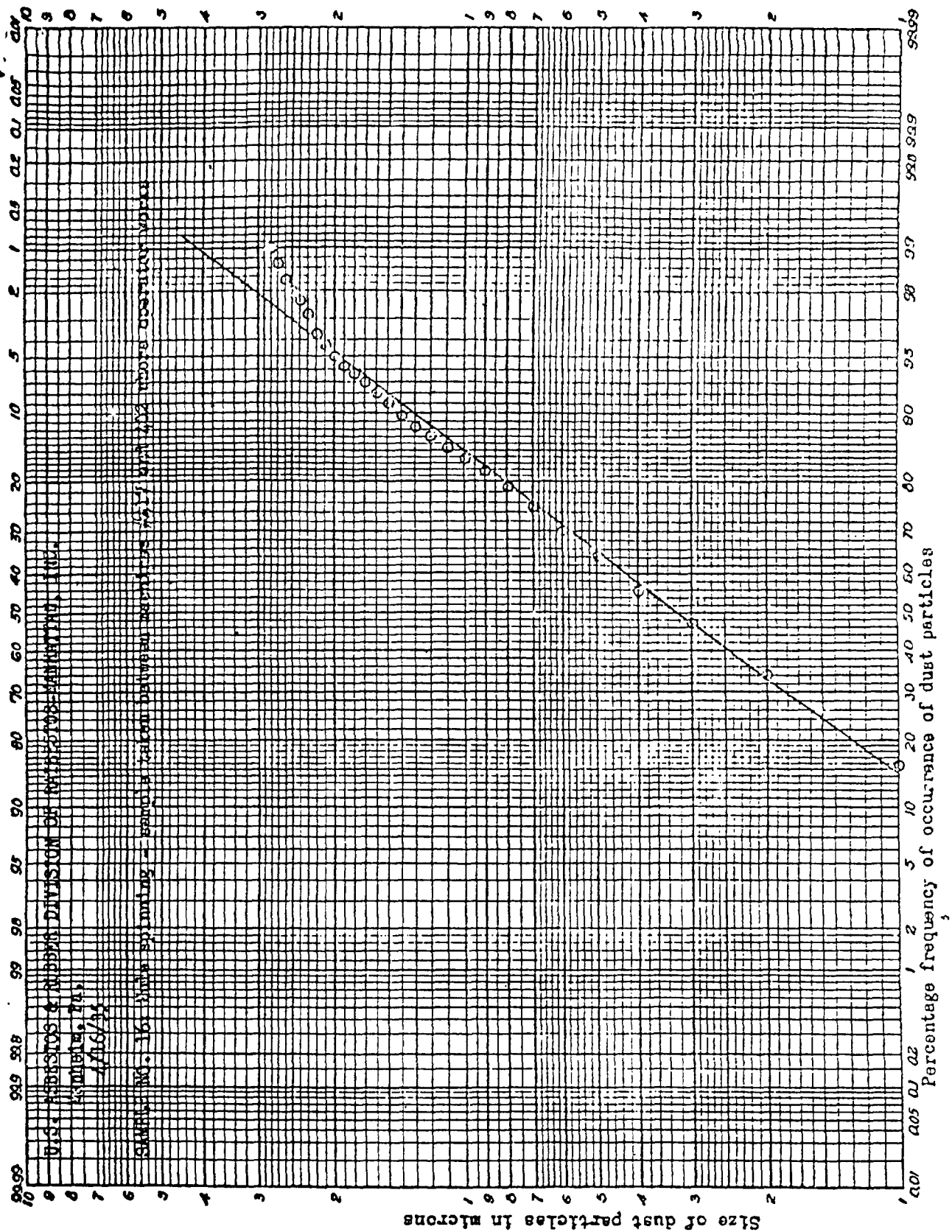




U.S. BUREAU OF MINES DIVISION OF MINERAL INDUSTRIES

WASH. D.C.

Sample No. 123456789 - Analysis of dust particles

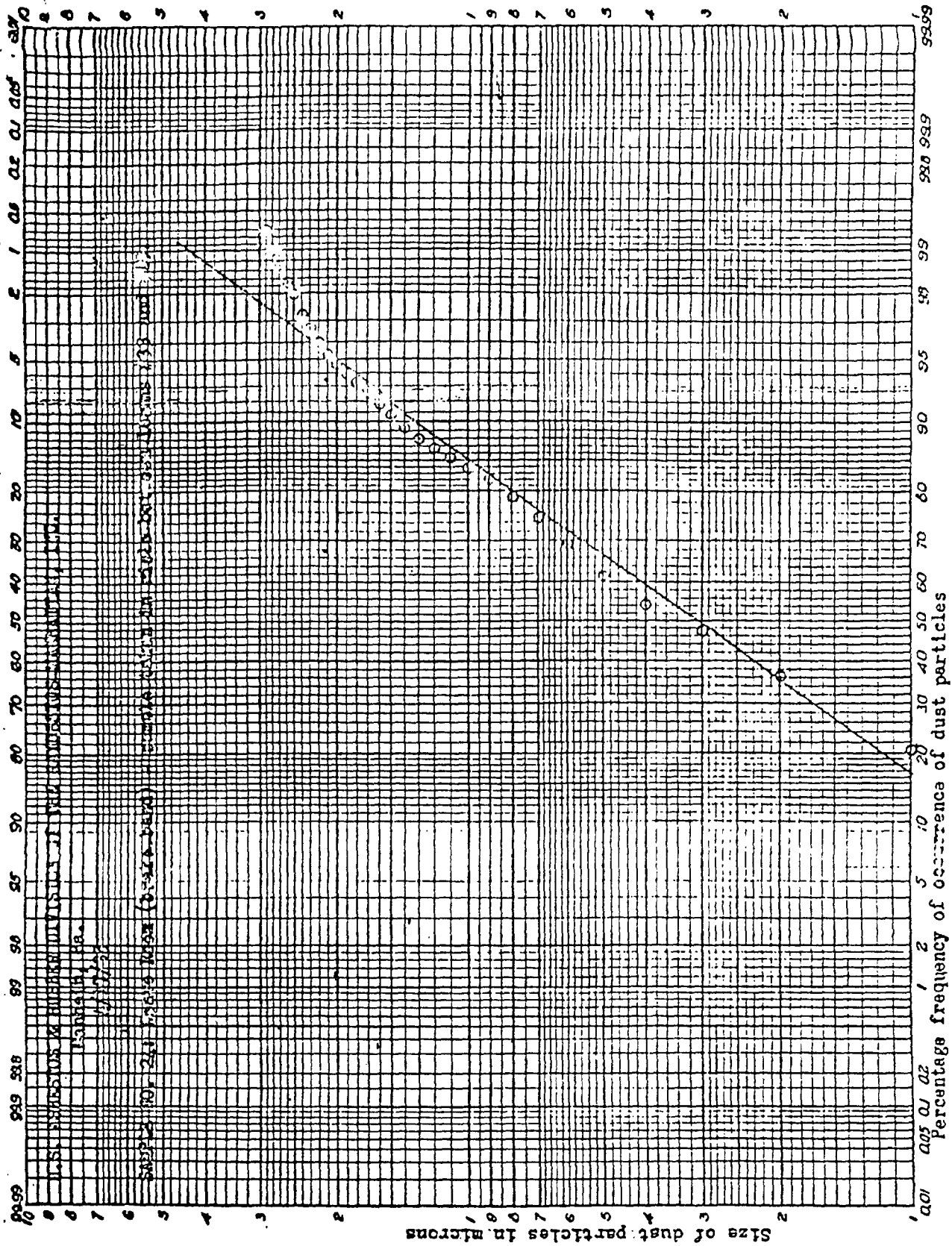


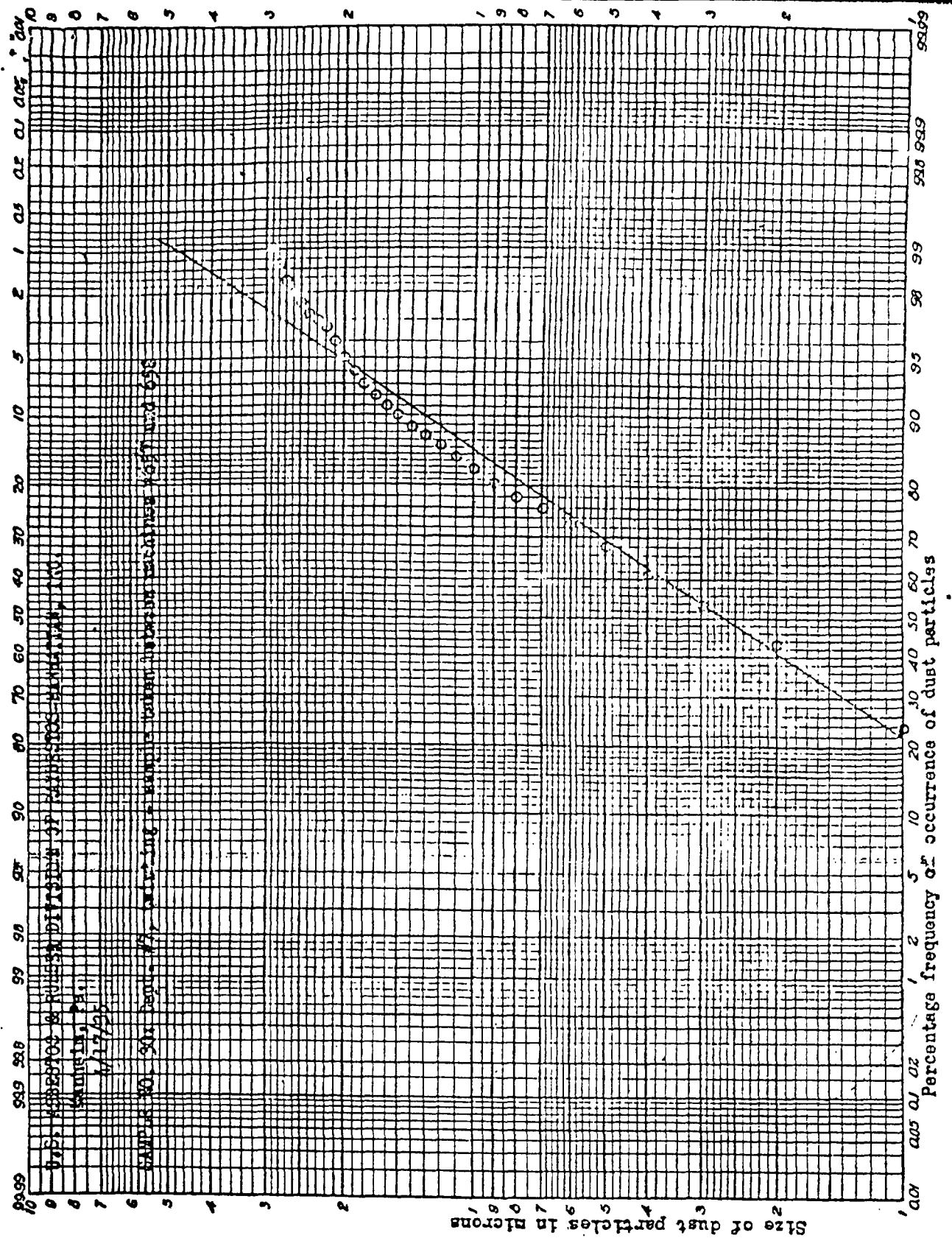
U.S. ARMY DIVISION OF RESEARCH AND DEVELOPMENT, INC.

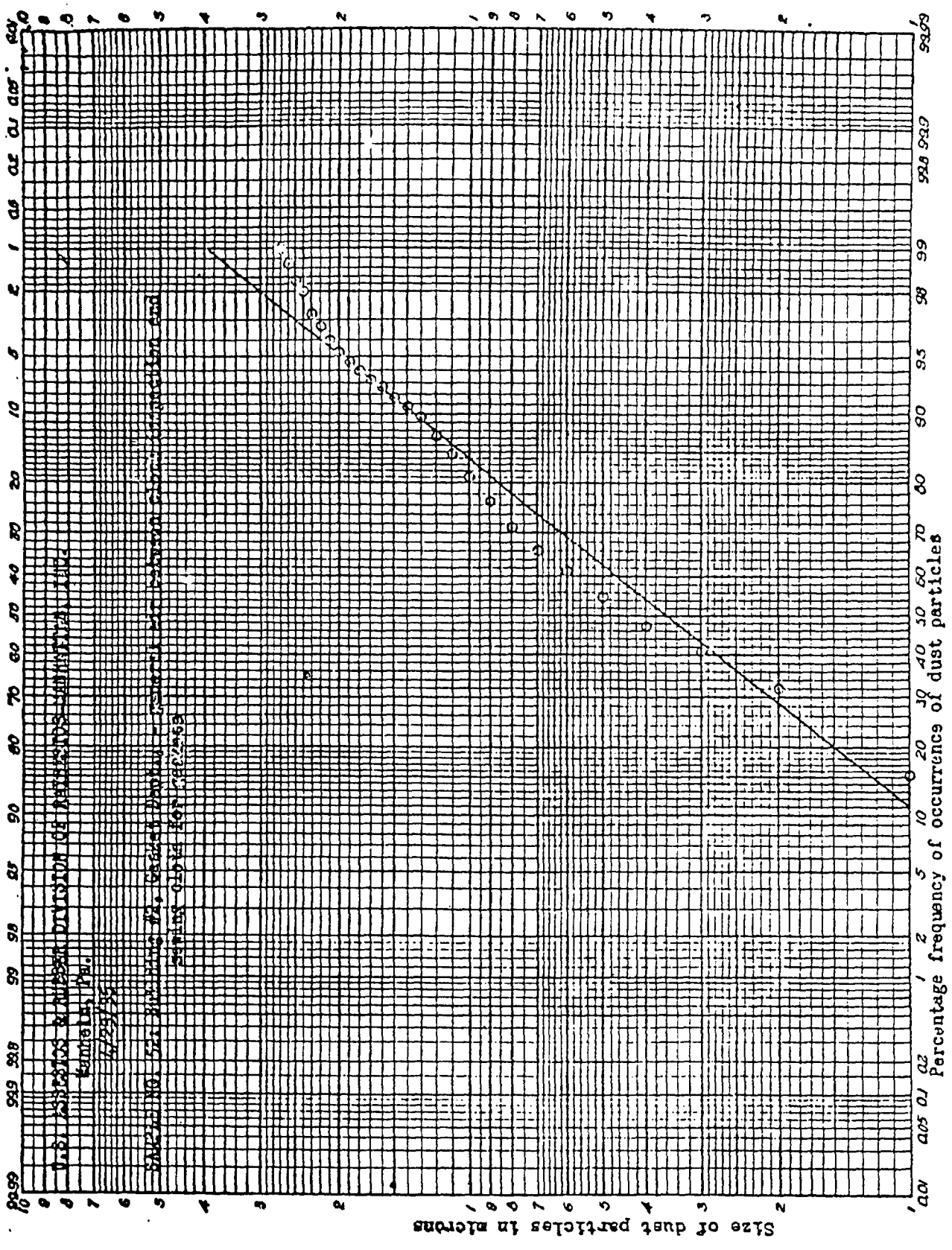
AMSTERDAM, N.Y.

7/16/34

SAMPLE NO. 161 Data obtained from analysis of 161 dust particles occurring in







U.S. BUREAU OF MINES DIVISION OF MINERAL INDUSTRIES
 Pittsburgh, Pa.

7/29/35

SAUCER NO. 121, Building 12A, Federal Building - General Post Office, Washington, D.C.
 Section of the U.S. Bureau of Mines