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THE RAYBESTOS DIVISION OF RAYBESTOS-MANHATTAN, INC.

Bridgeport, Conn.

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The following report is a study of the dust conditions in the Bridgeport and Stratford, Conn. plants of the Raybestos-Manhatten, Inc. and was conducted in June, 1935. This survey is supplementary to the survey made in February and March, 1930.

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Exhibit D

The Bridgeport Plant

The Bridgeport plant engages in the weaving of brake-band lining and clutch facing and the treatment and processing of the same. The buildings and processes are the same as at the time of the first survey, but the majority of the looms have been changed from their previous locations.

The methods used in the collecting of dust samples and counting are identical with those given in reports of other plants of this company and as outlined in the United States Public Health Service Bulletin No. 144, Treasury Department, Washington, D.C.

Looms and Stock Run at Time of this Survey - 3rd Floor

Loom #54
4 space Fletcher
2 5/16 x 1/8 ring stock
2 7/16 x 133 " "
2 5/16 - 1032 mule
2 7/16) 1030 - 1 cotton
) 1033 - 1 cotton
wet filling

Loom #55
12 space C & K
2 9/16 x 5/32 ring stock
1030 - 1 cotton
1033 - 1 cotton

wet filling

Loom #60
12 space C & K
2 x 1/4
2 1/4 x 1/4 Raybestos
2 1/2 x 1/4
1032 mule yarn
wet filling

Loom #61
12 space Fletcher
2 x 3/16 Raybestos
1032 mule yarn

wet filling

Loom #69
20 space C & K
1 3/4 x 3/16 - 05
820 - 30% cotton yarn
1022 zinc yarn

wet filling

Loom #70
20 space C & K
1 1/2 x 3/16 - 05
1 3/4 x 3/16
820 - 30% cotton yarn
1022 zinc yarn

wet filling
dry binder

Loom #71
20 space C & K
1 1/2 x 5/32 - 05
820 - 30% cotton yarn
1022 zinc yarn wet filling dry binder

2nd floor

Loom #9

12 space C & K
2 9/16 x 5/32 ring stock
1030 - 1 cotton yarn
1033 - 1 " "
wet filling
dry binder

Loom #10

12 space C & K
1 3/4 x 1/4 - 05
2 1/2
820 - 30% cotton yarn
1022 zinc yarn
wet filling
dry binder

Loom #24

12 space C & K
2 3/8 x 245 - 05
820 - 30% cotton yarn
1022 - zinc yarn
wet filling
wet binder

Loom #25

12 space C & K
2 x 3/16 - 05
820 - 30% cotton yarn
1022 - zinc yarn
wet filling
dry binder

Loom #27

16 space Fletcher
2 x 3/16 Raybestos
1032 mule yarn
wet filling
dry binder

Loom #30

16 space Fletcher
2 x 3/16 Raybestos
1032 mule yarn
wet filling
dry binder

Loom #44

6 space C & K
3 x 5/16
4 x 5/16 Free wheeling
4 1/2 x 5/16
1030-2 cotton yarn,
1033 - 1 cotton yarn
1032 - 1 cotton zinc yarn
1030 - 1 cotton yarn
wet filling
partially wet binder

Loom #46

10 space C & K
3 x 3/8
3 1/2 x 3/8 Raybestos
4 x 3/8
1033 mule yarn
wet filling
dry binder

Loom #50

20 space C & K
1 1/2 x 5/32 - 05
820 - 30% cotton yarn
1022 zinc yarn
wet filling
dry binder

1st floor

Loom #82

4 space Fletcher
5 x 5/16 Raybestos
1033 mule yarn
wet filling
partially wet binder

Loom #83

2 space Fletcher
9 x 1 no wire
9 3/4 x 1
1030 - 2 cotton yarn
dry weaving

Loom #86 - warp room

3 space Fletcher
12 x 3/8 industrial automotive
1032 - 1 cotton zinc yarn
1033 - 1 cotton yarn
1030 - 1 " "
1030 - 2 " "
wet filling
wet binder

Air Velocities - Taken with Anemometer at Exhaust Intake

Bridgeport Plant

Pratt & Whitney Grinder - 925 feet per minute

Automatic drillers - 1028 feet per minute

2nd floor - inspection table
machine on north side - 270 feet per minute
" " south side - 58 feet per minute

The following table shows the results of analysis of air samples taken at representative positions:

THE RAYBESTOS DIVISION OF RAYBESTOS-MANHATTAN, INC.

Bridgeport, Conn.

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
3rd FLOOR								
1	Between looms #60 and 61	6/19/35	44.7	6.1	5.3	3✓	Asbestos	1 man on each loom
2	Between looms #70 and 71	"	49.5	5.5	4.7	✓8	"	1 man on each loom; under belt drive
4	At loom #69	"	58.9	6.1	5.3	3✓	"	#68 not running; not under belt drive
5	Between looms #54 and 55	"	53.8	5.2	4.5	27	"	
8	General air, center of room near loom #75	"	38.1	5.4	4.6	✓8	"	
33	Same as #4	6/24/35	30.4	6.0	5.2	3✓	"	Monday morning after starting up; looms blown off on Friday
2nd FLOOR								
3	At loom #50	6/19/35	46.2	5.5	4.6	29	"	
6	At loom #44	"	61.6	3.1	2.6	15	"	
7	At loom #30	"	43.3	3.6	3.0	18	"	
9	At loom #27	"	39.6	7.5	6.3	38	"	
10	At loom #24	"	57.3	3.0	2.5	15	"	
11	At loom #25	"	77.8	3.5	2.9	17	"	
12	Between looms #9 and 10	"	42.2	9.9	8.3	56	"	
14	At loom #46	6/20/35	40.3	4.8	4.0	22	"	
15	At inspection table for woven stock	"	34.1	9.6	8.1	51	"	Exhaust system on brushes
21	Winding and measuring woven stock	"	28.7	8.1	6.8	46	"	
32	Same as #9	6/24/35	32.9	5.5	4.6	27	"	Monday morning after starting up; looms blown off Friday
34	At loom #[illegible] Using stuffed [illegible] lining	6/27/35	29.3	4.5	3.8	2V	Asbestos lead	
1st FLOOR								
19	At loom #3[illegible]; all will brake lining	6/19/35	38.4	3.6	3.3	20	Asbestos	4 looms in room #12 only one running

16	Between looms #32 and 33	6/20/35	39.7	2.5	2.3		"	2 looms running; operator of #43 and warp by hand
17	At loom #36; warping room	"	33.2	1.7	1.6	[illegible]	"	12 inch lining
19	At warp machines #1 and 2	"	56.6	3.3	3.1	10	"	#20 stock
22	At warp machine #7	"	55.6	5.8	5.4	37	"	Mule 1933-1 cotton
25	General air - cop winders	"	80.3	2.6	2.4	15	"	1027 zinc wire; 1030-1 cotton; 203" brass wire
BRAKE DEPT. 1st FLOOR								
18	General air inspecting and packing brake lining	"	36.6	1.3	1.1	7	Brake lining	3 men
20	General air, near small press for clutch facing	"	36.8	1.7	1.5	9	"	3 men rolling lining 1 man cutting lining
23	Between two large knuckle presses; woven clutch facing	"	64.6	2.0	1.8	11	Clutch facing	
26	Between two drill presses drilling rivet holes	"	25.5	3.1	2.7	16	Brake lining	Exhaust system; air hose used to clean machine
28	Same as #26	6/21/35	29.6	2.2	1.9	11	"	
29	At Pratt & Whitney grinder; woven brake lining	"	27.6	2.2	1.9	11	"	Exhaust system
31	General air, machine shop	"	38.5	2.2	1.9	11	Clutch facing brake lining	
24	General air, saturation room	6/20/35	97.6	0.95	0.86	5	"	
27	General air, shipping bldg.	6/21/35	43.9	1.0	0.93	5	"	
30	Normal outside air	"	48.0	0.5	0.45	3		

RAFTER DUST ANALYSIS

Brake Department 1.54% Pb
At looms #28 and 29 38.16% Pb 14.7% SiO_2 (total) (no free silica)

RELATIVE HUMIDITY

3rd floor - 6/19/35 - 64%
2nd floor - " - 57%
outside - " - 78%
1st floor - 6/20/35 - 67% - room with four looms
1st floor - " - 64% - warping room
1st floor - " - 55% - brake department
outside - " - 89%

All yarn used at this time averages 75% asbestos and 25% cotton.

RAYBESTOS DIVISION OF RAYBESTOS-MANHATTAN, INC.

Bridgeport, Conn.

LEAD ANALYSES

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Milligrams of Lead per cu. ft. air sampled	Milligrams of Lead per cubic meter of air	Lead Intake in Milligrams on basis of workman breathing 10 cubic meters air in 10-hr. day	Type of Dust
34	At loom #29; Buick stuffed .04 lining	6/27/35	29.3	0.00065	0.023	0.23	Asbestos lead
20	General air near small press for clutch facing	6/20/35	36.8	0.000	0.000	0.00	Brake lining
23	Between two large knuckle presses; woven clutch facing	"	64.6	0.000	0.000	0.00	Clutch facing
26	Between two drill presses drilling rivet holes	"	25.5	0.000	0.000	0.00	Brake lining
28	Same as #26	6/21/35	29.6	0.000	0.000	0.00	"
29	At Pratt & Whitney grinder woven brake lining	"	27.6	0.00069	0.0244	0.244	" Lead
31	General air machine shop	"	38.5	0.000	0.000	0.000	Brake lining clutch facing
24	General air - saturation room	6/20/35	97.6	0.000	0.000	0.000	"

Comparative Data of 1930 Survey and 1935 Survey

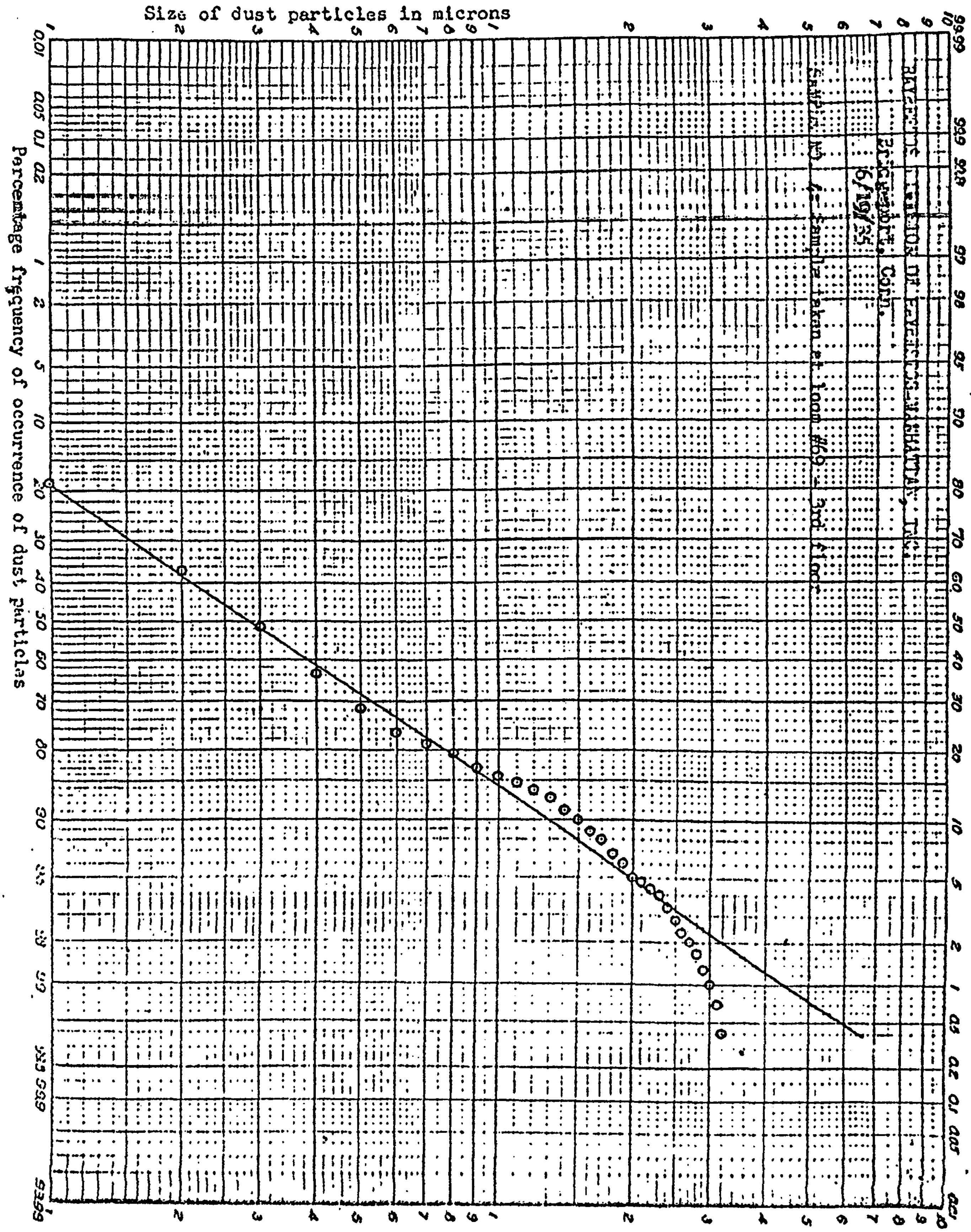
Bridgeport Plant	Millions of Particles per cu. ft. of Air Sampled			
3rd floor	1930		1935	
Between looms #60 and 61	1,380,000	8	6,100,000	[illegible]
" " #70 and 71	1,000,000	6	5,500,000	33
Average of 3rd floor counts	1,950,000	12	5,700,000	35
2nd floor				
Average of 2nd floor counts	2,970,000	18	5,700,000	35
1st floor - warp room				
Average of counts	4,685,000	28	3,100,000	18

CONCLUSIONS AND RECOMMENDATIONS - Bridgeport Plant

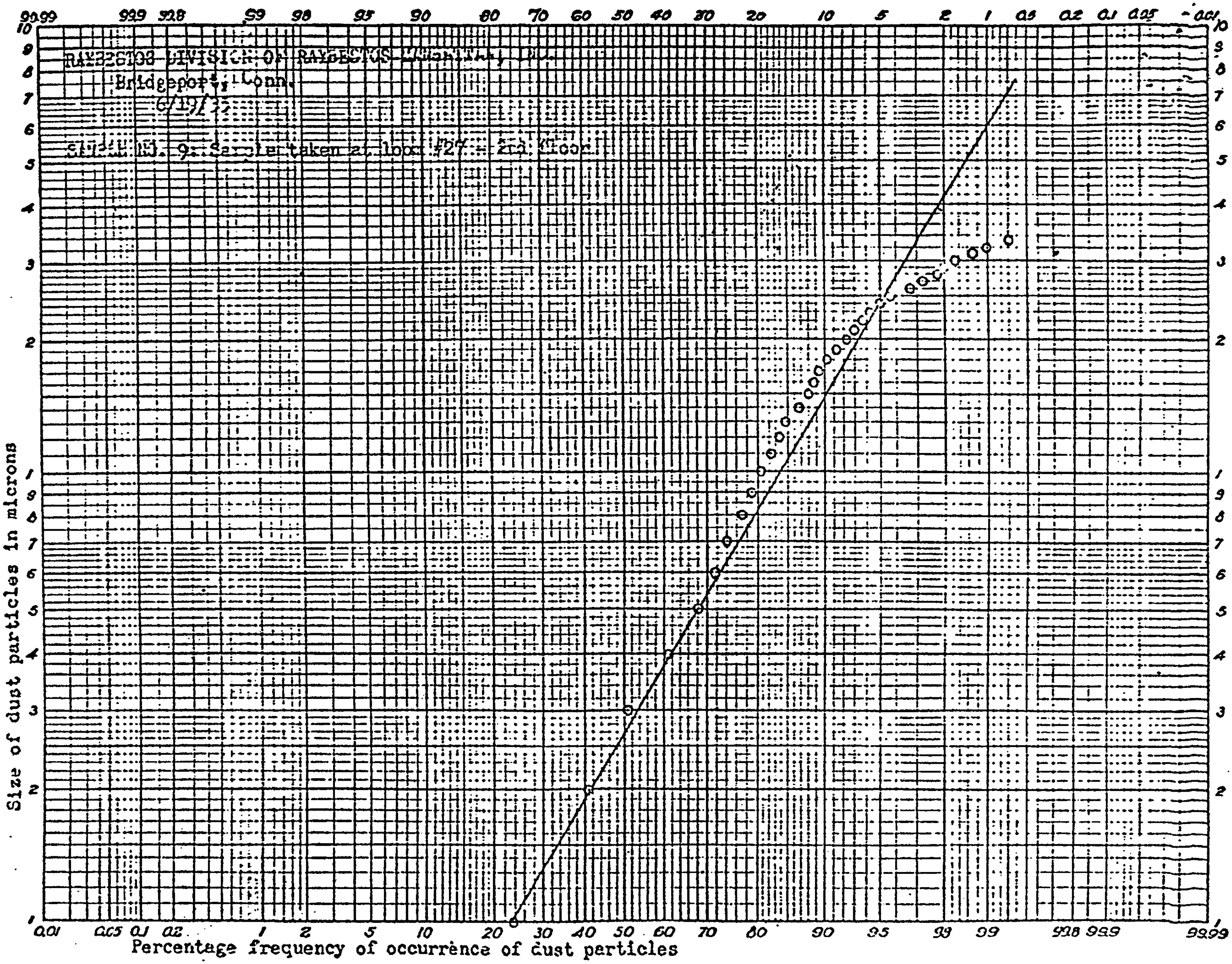
All of the dust counts in this plant show less than ten million particles per cubic foot of air sampled. While these counts are not considered as dangerous concentrations, they are much higher than on the previous survey made in 1930, with the exception of those in the warp room. All but four of the looms have been moved to different locations since the first survey. A check of the records would show a comparison of the type of yarn used and rate of production at the time of the two surveys.

Sample #15, taken at the inspection table on the second floor shows the highest count. The concentration at this point could be decreased materially by the proper exhaust equipment. The present system is not designed properly to take care of the dust generated.

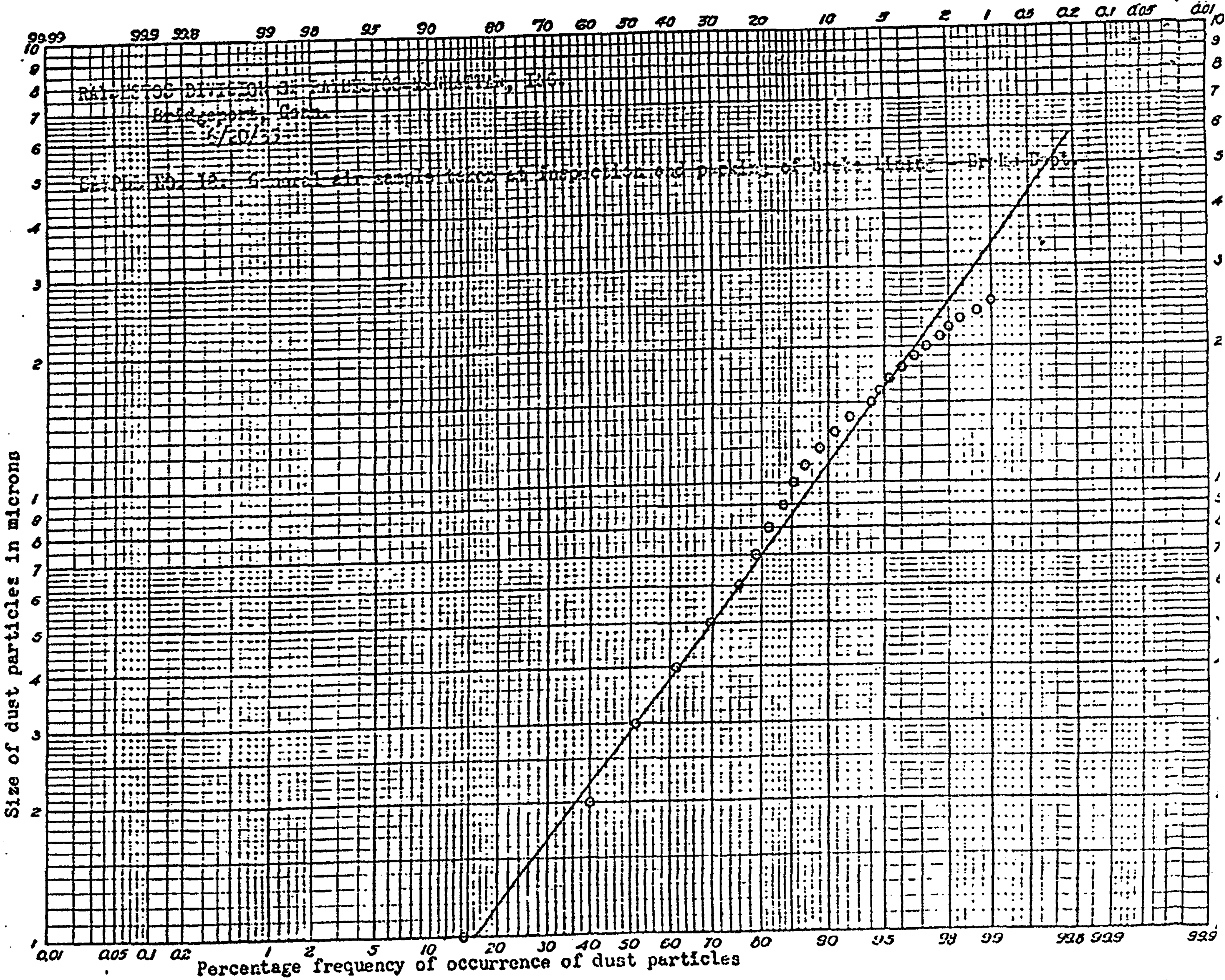
Sample #34 shows the presence of lead. This amount is not considered dangerous, but it would be advisable to have the workmen at these looms examined periodically for any signs of lead poisoning. The only sample in the Brake Department showing lead was sample #29. This is not considered a dangerous amount, but does indicate that there is a potential hazard present.

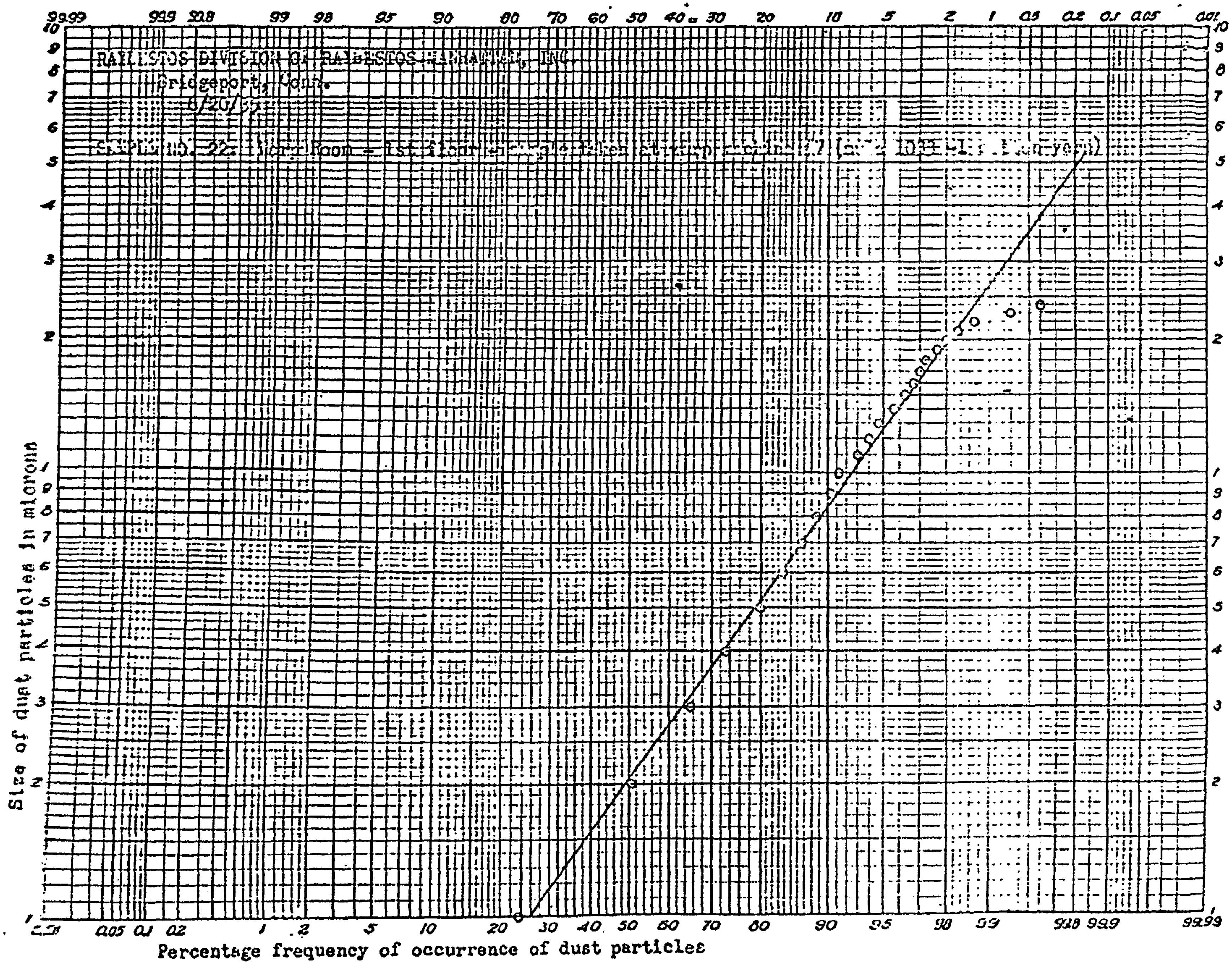


Size of dust particles in microns
Percentage frequency of occurrence of dust particles
Conn.
6/19/35
taken at Room #69 - 3rd floor



Bridgeport, Conn.
Size of dust particles in microns
Percentage frequency of occurrence of dust particles


Size of dust particles in microns
Percentage frequency of occurrence of dust particles


Bridgeport, Conn.
Room - 1st floor
Size of dust particles in microns
Percentage frequency of occurrence of dust particles

Stratford Plant

The Stratford plant engages in the manufacture of molded brake lining, molded clutch facing and packing.

The molded type brake lining is made in two different processes. One type is made by mixing asbestos, rubber, litharge, mica, whiting, sulphur, zinc oxide and high test gasoline in a mixer. This mixture is formed into sheets by ordinary rubber mills with heated rolls. The sheets are cut into strips for brake lining.

The second type is made of a mixture of rubber, asbestos, litharge, sulphur, zinc oxide and resin. This dry mixture is made into sheets by means of an hydraulic press. The sheets are cured in steam-heated presses. Strips for brake lining are cut from these sheets. Both types of lining are ground to width and thickness on Gardner grinders or Blanchard grinders. The lining is formed into arcs in heated presses and holes are drilled for rivets on automatic drill presses.

Molded type clutch facing is made from asbestos board. Asbestos and water are mixed in beaters to a pulp. This pulp is made into sheets on wet process machines. The sheets are dried in ovens and rolled to thickness in calenders. The large sheets are cut into strips from which the clutch facing rings are punched. The rings are impregnated in large tanks. Different specifications call for different saturants. The rings are ground to thickness on Blanchard grinders. The inside diameters are ground in internal grinders and the outside diameters are ground on external grinders. Rivet holes are drilled on automatic drillers. The finished clutch facing is then inspected before packing for shipment. Sheet packing is made from a mixture of asbestos, rubber, litharge, whiting, sulphur, zinc oxide and high test gasoline. These materials are mixed in closed mixers. The wet mix is made into large sheets in mills with heated rolls. It is either sold in large sheets or it is cut into gaskets or rings on punch presses. The vapor arising from the heated rolls, due to the gasoline, is collected by hoods and pipes and reclaimed in two large condensers.

The following tables show the results of analyses of air samples taken at representative positions:

THE RAYBESTOS DIVISION OF RAYBESTOS-MANHATTAN, INC.

Stratford, Conn.

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	Milligrams of Lead per cu. ft. air	Milligrams of Lead per cubic meter of air	Lead Intake in milligrams per 10-hr. day on basis of average breathing 10 cubic meters of air	Type of Dust	Remarks
Bldg. 8										
1	At pulverizer, waste stock	6/25/35	49.0	4.7	4.2	0.000	0.000	0.000	Asbestos	Exhaust system fibre room
2	General air, between mixers #11 and 12	"	49.3	2.3	9.1	0.000386	0.0136	0.136	Asbestos litharge mica, whiting rubber	Mixers closed while running
3	Taken at mill #9 cardinal brake stock	"	46.7	3.9	3.5	0.00041	0.0145	0.145	"	
4	General air between mixers #5, 9, 17 & 18	"	50.5	2.6	2.3	0.00226	0.080	0.80	"	
5	Taken at mill #1 1507 sheet packing	"	53.5	2.0	1.8	0.000	0.000	0.000	"	Machine #550
6	At fibre opener, truck being filled; hand truck about six feet from opener	"	8.5	20.0	18.0	—	—	—	Asbestos	Shovels fibre off floor fibre comes back into truck through pipe
7	General air, taken near power shear and punch presses	"	42.7	1.2	1.1	0.000	0.000	0.000	Asbestos litharge whiting rubber	
8	Between mills, machines #345 and 346 453A brake lining	"	54.7	3.8	3.4	0.000	0.000	0.000	"	Two mixers near
10	General air, taken near gasoline condenser	"	53.6	2.0	1.8	0.000	0.000	0.000	"	
Main Bldg.										
11	At wet machine #3	"	56.7	2.4	1.9	—	—	—	Asbestos	Asbestos board
12	At punch press machine #15, beside girl stacking and piling	"	46.0	4.4	3.4	—	—	—	"	Clutch facing rings
13	Dumping asbestos and waste asbestos board into beaters	6/26/35	105.0	1.4	1.1	—	—	—	"	Taken while three beaters were being filled
14	General air, taken near calender for pressing asbestos board to thickness desired	"	48.9	1.8	1.4	—	—	—	"	
15	General air, inspection of brake lining	"	40.0	2.8	2.3	0.000475	0.0168	0.168	Brake lining clutch facing	5 women - 5 men
16	General air, inspection of clutch facing and brake lining	"	49.1	1.4	1.1	0.000	0.000	0.000	"	Shipping
17	Between power shears #3 and #4, cutting asbestos board	"	48.4	1.6	1.2	—	—	—	Asbestos	2 men at #3 1 man at #5
18	At Blanchard grinder #1 clutch facing	"	35.4	6.5	5.2	0.000	0.000	0.000	Clutch facing	Exhaust system - 1 man
19	Between 3 women at inspection machines for brake lining	"	42.1	1.0	0.81	0.000	0.000	0.000	Brake lining	
20	At Cincinnati grinder clutch facing	"	41.2	1.4	1.1	0.000	0.000	0.000	Clutch facing	Exhaust system
21	Between 2 flat sanders	"	44.1	6.8	5.5	0.000	0.000	0.000	"	1 sanding washer strips 1 sanding clutch facing
22	At automatic drill press machine #40	"	44.5	2.6	2.1	0.000	0.000	0.000	"	Exhaust system
23	At drill press machine #70	"	41.6	8.2	6.6	0.000	0.000	0.000	Brake lining	Exhaust system
24	At belt sander machine #125, outside of brake lining	"	40.8	1.9	1.5	0.00031	0.011	0.11	"	" "
25	At internal grinder machine #102	"	3.7	18.4	14.8	—	—	—	"	" "
26	At external grinder machine #105	"	11.3	12.0	9.7	—	—	—	"	" "
27	At internal grinder machine #46	"	37.7	4.1	3.3	0.000	0.000	0.000	Clutch facing	" "
28	At internal sander machine #124	"	46.4	1.8	1.5	0.00082	0.029	0.29	Brake lining	" "
29	At press #230, making molded sheet lining	"	55.4	1.4	1.1	0.000	0.000	0.000	"	F.O. material
30	Between two Blanchard grinders, #3 and 4	"	42.1	12.8	10.3	0.0027	0.095	0.95	"	#3 - F.O. brake lining #4 " " " blows off material with air hose before reversing sides; exhaust system
31	At Kingsbury automatic drilling machine #1	6/27/35	44.2	1.7	1.4	0.00043	0.0152	0.152	"	Exhaust system
32	At sander machine #92, brake lining	"	29.5	2.3	1.9	0.000645	0.0228	0.228	"	2 men - exhaust system

BAFFLE DUST ANALYSIS

Fibre room	0.61% Pb	30.21% SiO_2 (total)	no free silica
Over beaters		70.46% SiO_2	"
Over drills, grinders,	4.70% Pb		

Comparative Data of 1930 Survey and 1935 Survey

Stratford Plant

	1930	1935
Cincinati grinder	655,000	1,400,000
Filling beaters	529,000	1,400,000

Air velocity readings - taken with anemometer

Fibre room - pulverizor - 590 feet per minute
fibre opener 1450 " " "

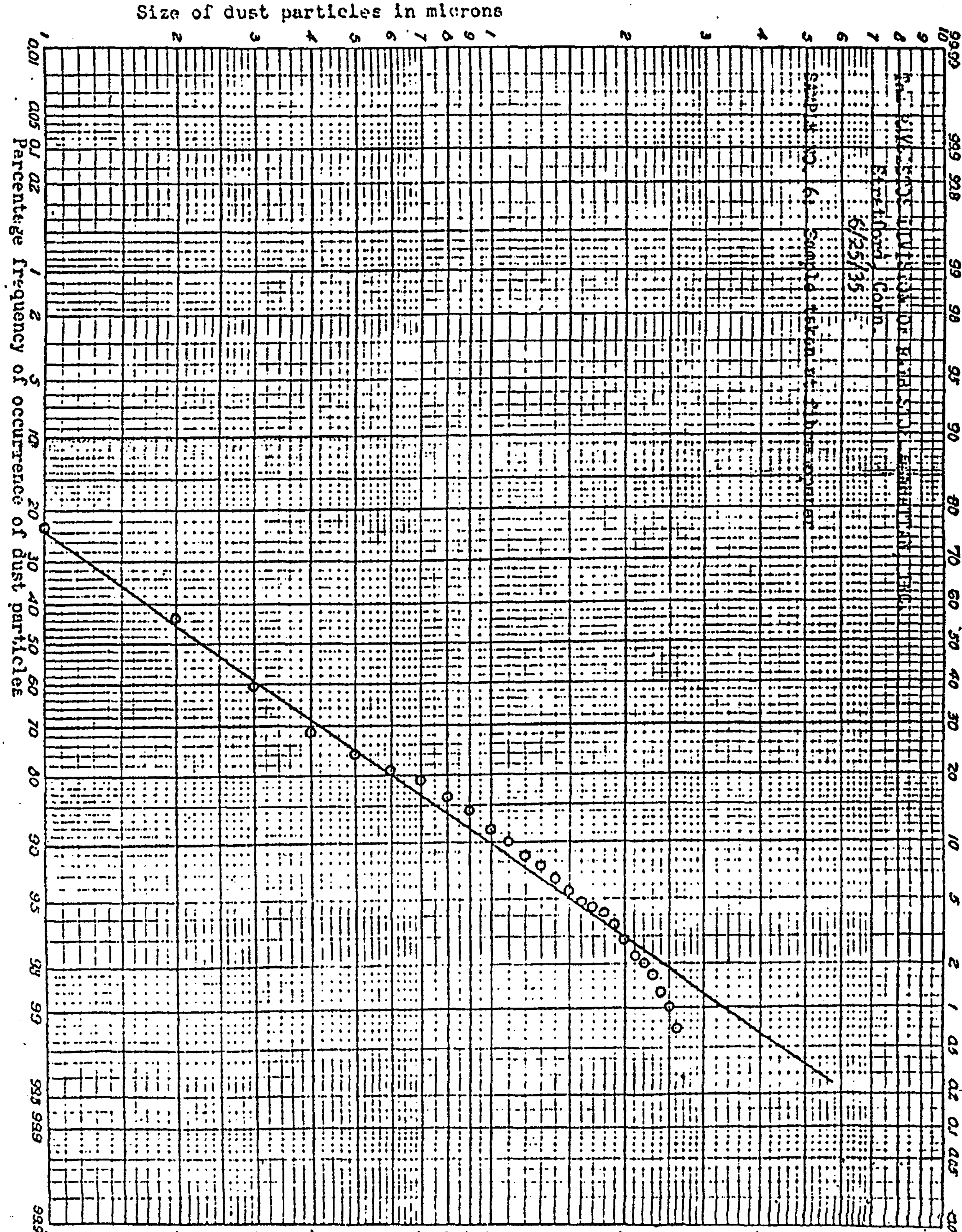
Blanchard grinder #4 - - 590 " " " (right side)
1514 " " " (left side)

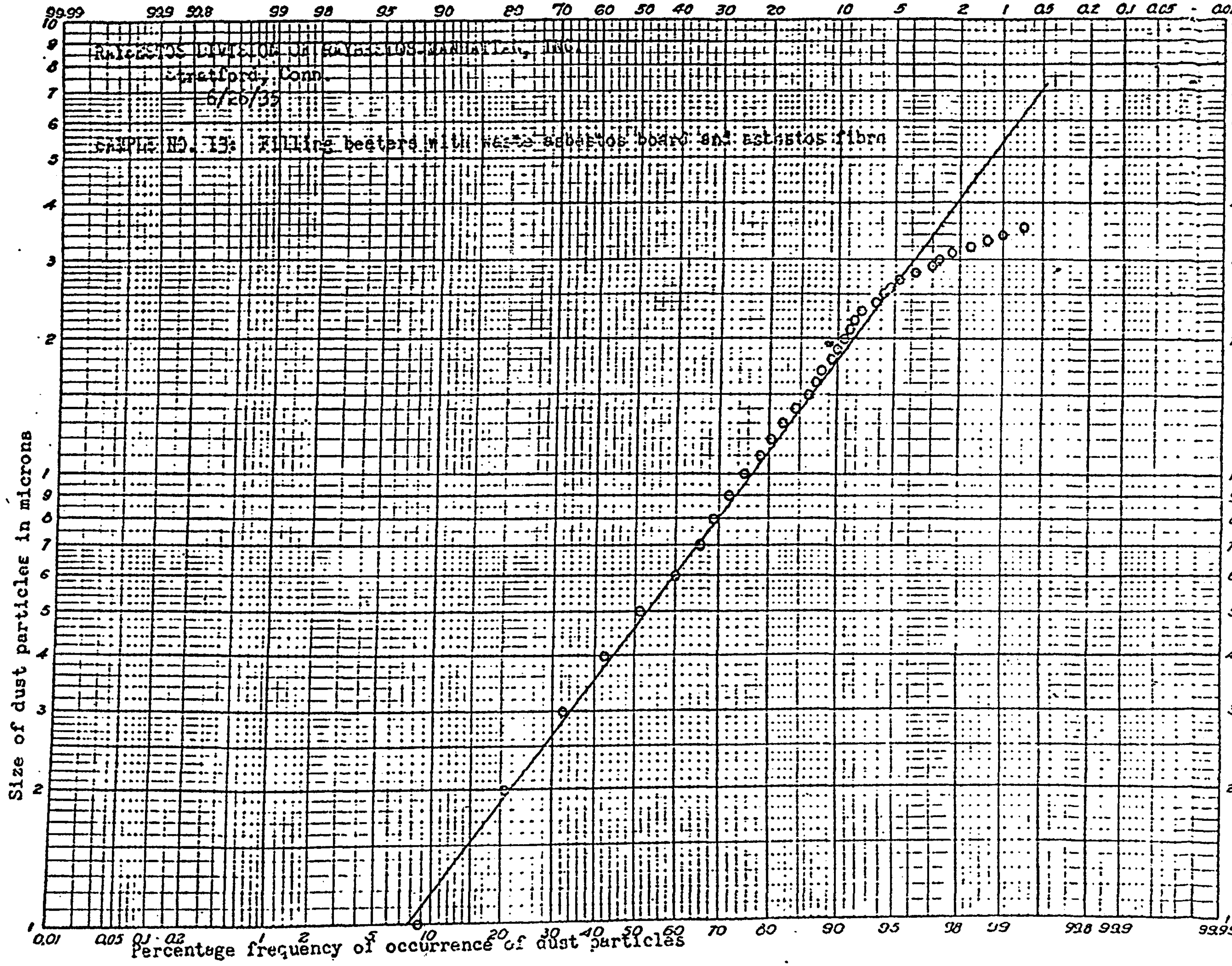
Drill press machine #70 - - 571 " " "

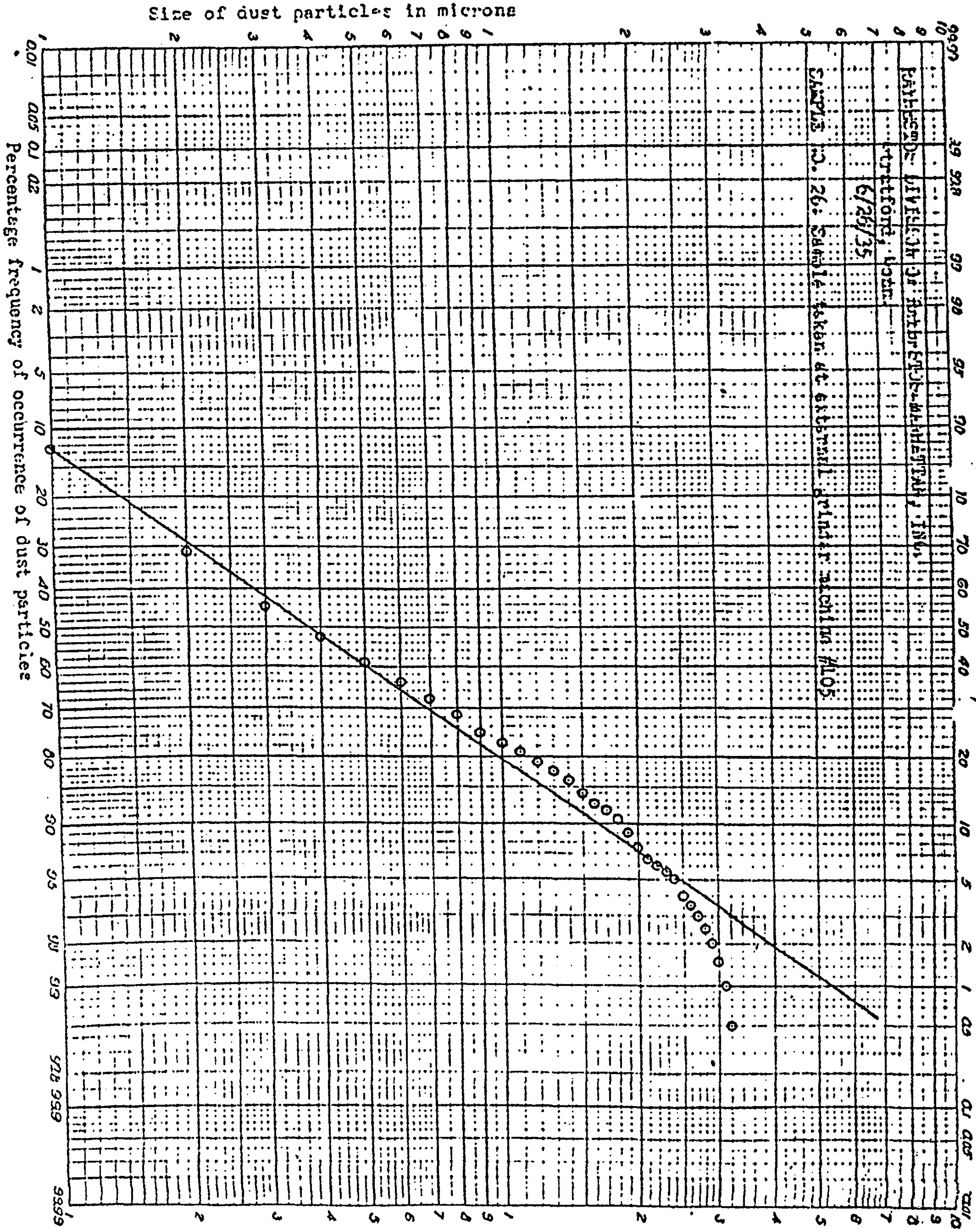
Internal grinder machine #102
large opening - 1111 " " "
small openings 434 " " "

External grinder machine #105 200 " " "

Sander machine #92 743 " " "


Size of dust particles in microns
Percentage frequency of occurrence of dust particles
6/25/35


Stratford, Conn.
6/26/35
Filling beaters
Size of dust particles in microns
Percentage frequency of occurrence of dust particles


Size of dust particles in microns
Percentage frequency of occurrence of dust particles
6/26/35

CONCLUSIONS AND RECOMMENDATIONS - Stratford Plant

Sample #6 taken at the fibre opener shows a high dust count. This is accounted for by the method of handling the fibre and not the opener itself. The fibre is dumped from bags onto the floor and then shoveled into the opener. The fibre is carried to a hopper above and then falls through a pipe into a truck which is located about six feet from the opener. The operator stands between the opener and the truck and shovels the fibre into the opener at the same time that it is falling into the truck. The dust concentration at this point could be decreased by the proper handling of the fibre.

Samples #2, 3 and 4 show that there is lead present in the air at these points. While these samples do not show a dangerous amount, it would be well if the workmen engaged at these places were examined periodically for signs of lead poisoning. Notice was taken at the time of this survey of the method of handling litharge. This material is handled carelessly as it can be found lying on the floor in the room where it is weighed and around the mixers.

Sample #13 shows a low count. Three men were engaged in filling the beaters. Practically all of the material put into the beaters was waste asbestos board. Very little raw asbestos was added. No doubt the count at this position would be higher if more raw asbestos fibre were used out of the bags. It is recommended that the bags of asbestos fibre be stored in a room isolated from the remainder of the plant. This would eliminate dust generated in the piling and unpiling of these bags in the room and exposing more people to the dust than is necessary.

Samples #15, 24, 28, 30, 31 and 32 all show that lead was present in the air sampled. Sample #30 is the only one that approaches a dangerous amount.

This sample also shows a high dust count. The high dust count at the two Blanchard grinders #3 and 4 is due to the method of handling the brake lining during the grinding operation. This lining is the P.G. molded type and a number of strips are placed together for grinding of the edges. After the edges are ground on one side, the operator blows off the clinging dust with an air hose and reverses the strips to grind the opposite edges. This type of grinding should be done on the grinding machines designed for this particular work. It was observed that a great amount of the dust present in the air is caused by the handling of the material after grinding. Dust clings to the individual pieces, and when the stacks are moved about they are not put down carefully. This results in dust clouds arising.

Samples #25 and 26 show high counts. Large size brake lining was used at the time these samples were taken. It was observed that the exhaust hood on machine #105 did not catch all of the dust from this type lining. When smaller sizes of lining are ground on this machine the hood seems to catch most of the dust generated. The hood should be changed to take care of all sizes of lining ground on this machine.

HEALTH HAZARDS

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 any new facts discovered will be added to the general composite report of the asbestos plants survey which is to be brought out later.

Mica belongs to the class of materials in which silica occurs in a combined form known as silicates. Little or nothing is available in the literature with regard to the effects of this dust on the lungs, though it seems likely that it belongs with the more mildly injurious dusts. Our present knowledge of the effects of the silicates is meagre, but work is being carried on in various quarters in an attempt to determine their classification more accurately with regard to health. Experimental investigation of mica dust was made recently by A. Policard of the University of Lyons, France.(1) His conclusions from observations on white rats were that these dusts are noxious to the lung tissue, resulting after a time in changes in the cells and in phagocytosis and producing a mildly chronic fibrosis similar to that seen in silicosis. Mica particles grouped in plaques were found in the alveolar tissues. With his conclusions regarding the theory that sericite is the chief factor in the causation of silicosis, authorities in this country cannot agree, although the matter is constantly receiving attention.

Toxicity of Lead in Rubber Mixing (Litharge - red or yellow oxide of Lead)

Compounding and mixing are the most hazardous processes in rubber making. If these processes are properly isolated from the rest, compara-

(1)Policard, A., The Action of Mica Dust on Pulmonary Tissue, Journal of Industrial Hygiene, Baltimore, Vol. XVI, No. 3, May, 1934, pp. 160-164.

tively few workers need remain exposed.

Lead poisoning is the commonest of the industrial intoxications. The toxicity of lead depends upon a number of factors such as : the form of lead taken into the body - vapor, dust or solid; the solubility of the lead compound in human tissues; the mode of entry of lead into the body - inhalation, ingestion or skin absorption; the extent of exposure; individual susceptibility which is heightened by numerous conditions particularly by previous attacks of poisoning.

Among the most readily toxic of the inorganic lead compounds are the oxides, the carbonate, the sulphate and the chromate.

Lead is a cumulative poison and, with a few exceptions, industrial lead poisoning is usually a chronic condition caused by the inhalation or ingestion of small amounts of soluble lead over long periods of time. This process of poisoning may go on slowly for a long period without manifesting any of the characteristic acute symptoms. Lead inhaled, however, is far more rapidly and surely toxic than lead ingested, since it reaches the blood stream more directly and comparatively little is eliminated unabsorbed.

There is little agreement in the estimates made by various authorities on the minimum amount of lead which can cause poisoning if taken into the body. For practical guidance, however, it can be assumed that from 1 to 2 milligrams taken in daily over a period of months or years may cause poisoning. A number of factors also enter into the estimation of the amount of air breathed by a man at active work during the working day. Ten cubic meters of air in a ten hour day is an estimate which very probably errs on the safe side for the average workman. On the basis of these calculations, the lead content of the air of workrooms where men are continuously exposed should be kept as low as

0.1 of a milligram per cubic meter of air or else strict measures for protection should be installed to prevent poisoning.

The symptoms of chronic lead poisoning are many and may manifest themselves through the gastro-intestinal tract as in the familiar "lead colic" or the neuro-muscular system or both. Among the symptoms most commonly noted are colic, metallic taste in the mouth, obstinate constipation and loss of appetite, muscular weakness, particularly of the hands and wrists, neuritis and joint pains, loss of weight, headache, dizziness, nausea or vomiting, gastric distress or fatigue are among the minor symptoms that may or may not be present.

The principal diagnostic signs for the detection of lead poisoning in its early stages or of lead absorption, which is essentially pre-clinical poisoning before the onset of symptoms, are ashen pallor of the skin, tremor, lead line on the gums, stippling or basophilic degeneration of the red blood cells, hematoporphyrin in the urine and mild secondary anemia. Other abnormalities in the blood which are characteristic of lead poisoning are polychromatophilia, changed relative proportions of lymphocytes and polymorphonuclear leukocytes, increased mononuclear cells and increased reticulocytes.

Repeated physical examinations should be made of workers exposed to lead at fairly short intervals of from two to six months, depending upon the severity of exposure. It is important to prevent the occurrence of lead poisoning, since, even though it is not often fatal under modern conditions, it frequently results in premature development of chronic degenerative conditions in the circulatory system.

The physiochemistry of lead poisoning and the treatment to be pursued have been the subject of intensive experimentation and study by Aub[2] and his

(2)Aub, J.C., et al, Lead Poisoning, Williams and Wilkins, Balt. 1926, pp. 265.

associates at the Harvard School of Public Health and by Kehoe[3] and his colleagues of the University of Cincinnati.

Toxicity of Various Solvents and Plastics

Benzol is by far the most hazardous of the solvents commonly used in industry. It has been established that the maximum allowable concentration for prolonged exposure is 100 parts per million. Because of its recognized and very serious danger to the health of operatives, its use as a solvent in spray coating operations has been largely supplanted by less toxic substances or by its less harmful homologues toluol and xylol. These substances are not necessarily less dangerous to life if breathed in, but, because of a lower volatility and a marked odor, they are less likely to escape unnoticed into the atmosphere. Moreover, they do not damage the blood forming organs causing chronic permanent injury to health to the same extent as does benzol. Solvent naphtha derived from benzol is a mixture of toluol and xylol and in the same class with these substances with regard to health hazard, while petroleum naphtha is classed with benzine, gasoline, the chlorinated hydrocarbons and with the alcohols, acetates and ketones, and with which severe poisoning is rare. Whether or not these substances have any action on the blood is still controversial. Usually poisoning by them is of the acute anesthetic type. The effects due to exposure to heavy fumes are headache, nausea, dizziness, blurred vision, mental confusion and loss of consciousness. These effects generally disappear fairly quickly in fresh air. Chronic effects from prolonged exposure are less definite but similar, with muscular weakness, tremors, and various nervous disturbances.

Of the alcohols, all highly soluble, methyl alcohol or methanol is one of the most toxic to human beings when inhaled, inasmuch as it is not oxidized in the body to the same extent as ethyl alcohol, which is otherwise more toxic.

(3) Kehoe, R.A., Thamman, F., Cholak, J., On the Normal Absorption and Excretion of Lead, I-IV, Journal of Industrial Hygiene, Sept. 1933.

Some degree of tolerance can be developed to the anesthetic effect of the alcohols, particularly ethyl alcohol, probably due to acceleration of the normal rate of oxidation.

While methyl, butyl and amyl alcohol are increasingly toxic judged by their respective directly poisonous actions, this property is offset, as far as their industrial aspect is concerned, by a decreasing volatility and solubility.

As is the case with benzol, the toxicity of methanol has been blamed on its impurities, but there is ample evidence of a sound nature that methanol itself is the chief toxic factor. The effects of the vapor, accumulating as it readily does in the body, are directly poisonous to the nervous system, and have a special affinity for the retina. Large doses cause prolonged coma, blindness and death. The minimal toxic dosage is not well established. Henderson and Haggard[4] quote Loewy as putting it at 200 parts per million for experimental animals if inspired over a long period. It has been recommended that the concentration should be kept below 1 part per 10,000 parts of the air, or 100 parts per million.[5] Methyl alcohol, in addition to its toxicity, has an irritating effect on the skin.

<u>Bakelite - Formaldehyde fumes</u>

Practically nothing is known regarding the possible effects of bakelite dust on the respiratory system. The phenols in its composition might be potentially harmful if exposure to them in the form of concentrated vapors was sufficient. Cases of poisoning due to inhalation of formaldehyde vapors, except by accident, however, are rare due to its extremely irritating effect on the eyes and nose which usually causes workers to remove themselves from the

(4) Henderson, Yandell, and Haggard, H.W. (Yale University), Noxious Gases; Chemical Catalogue Co. Inc., N.Y.C., 1927, p. 157.

(5) International Labour Office, Occupation and Health Brochure No. 55, Geneva, 1926.

fumes before injury occurs. Concentrations of formaldehyde in excess of 20 - 200 parts per million may cause symptoms.[6]

In one case studied by a factory medical inspector in Holland marked nervous disorder with strong somnolence was attributed to such fumes.[7]

Skin affections due to bakelite are of frequent occurrence and are popularly known as "bakelite itch". The face and forearms are most commonly affected in workers handling these resins. Skin lesions are especially prevalent under conditions favoring perspiration. They may be avoided, therefore, by provisions for good ventilation and by frequent washing of the exposed skin in alkaline solutions. Unusually sensitive persons should be removed from this type of work.

Linseed Oil

In addition to the danger of spontaneous combustion, linseed oil when heated gives off irritating fumes of acrolein. No chronic ill-effects have been noted from this substance though it is irritating to the mucous membranes of the eyes, nose, and throat. The addition of resins to the mixture gives rise to volatile ethereal oils which have caused headaches, nausea and even stupor. Although Dr. Barnes[8] in a study of linseed dermatitis did not find the pure oil as irritating as linseed cake, dermatitis or infections, especially of the hands are common in workmen who come in contact with either of these substances.[9] Workers showing hypersensitivity to the oil may have to be removed from the work.

(6) Sayers, R.R. and Dallavalle, J.M., Prevention of Occupational Diseases, Mechanical Engineering, April, 1935, p. 232.
(7) International Labour Office, Geneva, 1928, Occupation and Health, Brochure #115, Bakelite.
(8) Barnes, M.H., M.D., Linseed Dermatitis, Journal of Industrial Hygiene, Vol. XIII, No. 2, February, 1931, pp. 49-55.
(9) U.S. Public Health Service, Treasury Dept., Wash. D.C., Public Health Bulletin No. 215, Skin Diseases in American Industry, 1934, pp. 41-45.

Skin Diseases

In addition to the toxic properties of the substances handled, occupational skin disease due to rubber compounds, to accelerators and anti-oxidents is very common in rubber workers and in those exposed to the above solvents and oils, especially those derived from coal tar products. There is attached our booklet entitled "Prevention of Oil Pimples" which describes some of the protective measures with which these skin troubles may be decreased.

One of the most frequent causes of dermatitis in the rubber industry is hexamethylenetetramine used as an accelerator and paraphenylendiamine or similar coal tar compounds. A one per cent solution of "hexy" is said to be sufficient to cause dermatitis and in hot weather skin trouble is almost inevitable if this substance is carelessly handled.

It is not, perhaps, sufficiently well understood that continued exposure to certain of these skin irritants may develop a sevsitivity in workers who did not at first appear to be susceptible. Once dermatitis from "hexy", for instance, has occurred, the individual is sensitized to the substance and, much as with poison ivy, is unable to tolerate even slight exposure thereafter without skin outbreaks. Heat usually quickens the reaction.

Protective ointment containing alkali has been recommended.

Dark, oily-skinned persons are usually more resistant to the irritating effects.

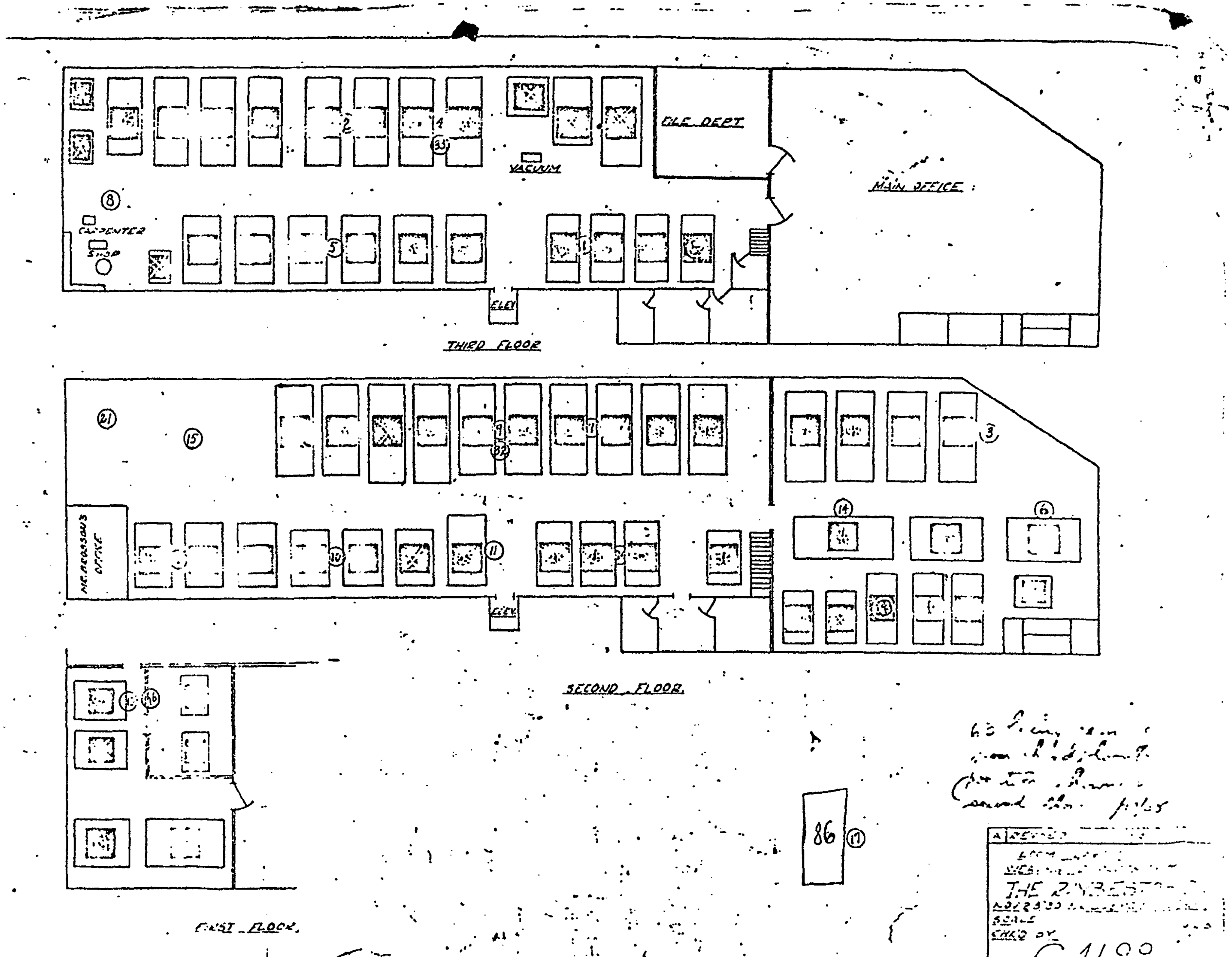
Those having frequent outbreaks of dermatitis or those found sensitive to these substances through patch tests should be transferred to other occupations.

Protective work clothing with provisions for changing it and good facilities for washing, together with the enforcement of rules regarding personal cleanliness, helps to prevent both skin troubles and cases of poisoning.(10)

Chrome

Chrome compounds and the health hazards associated with them are discussed in the accompanying booklet "Protection of Workers Exposed to Chromium and Its Compounds".

(10) U.S. Public Health Service, Public Health Bulletin #215, Skin Hazards in American Industry, Government Printing Office, Wash. D.C., 1934, pp. 1-10.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