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24.

The following report is a study of dust conditions in the Manville plant of the Johns Manville Company, undertaken during the months of October and November, 1929. It is the first unit in a series of such studies which it is planned to conduct in various establishments 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 effects to such workers.

The hazard of silica dust with special reference to the lungs has been long appreciated and a great deal of study and research has been applied to the silica dust problem, primarily in the metal mining industry, in Great Britain, the United States, and the British Dominions. The nature of the effects of silica dust expressed in the term "silicosis", with the resultant extraordinary predisposition to pulmonary tuberculosis, are well known. It has always been understood that silicosis is due to exposure to dust containing free silica. It is still a matter of controversy as to whether the dust of combined silica can produce silicosis, some authorities maintaining that combined silica dust produces a modified or milder type of silicosis.

In the last few years there have appeared articles, mostly in British medical journals, describing a pulmonary disease presumably due to the inhalation of asbestos dust and called asbestosis. Studies of this condition are suggestive, but still fragmentary and incomplete. In the United States compensation has been claimed and allowed in several cases of so-called asbestosis and the industry is desirous of knowing whether this disease is a true

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occupational hazard of asbestos manufacture and fabrication and if so, what can be done to lessen or prevent the hazard. Asbestos is a silicate of magnesium and it might be supposed, therefore, that asbestosis and silicosis are similar, though perhaps not identical in severity.

There does not appear to be present in places where asbestos is mined or fabricated the clear cut clinical picture which is so unmistakable in hard rock mining communities.

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.

It should be borne in mind that these dust diseases of the lungs develop very slowly, taking from five to fifteen and even twenty to twenty five years to become established, depending upon the dosage. The dosage, in turn, depends upon the amount of dust, the amount of silica in the dust, and the length of exposure to the dust - three variables. It is possible, therefore, that with the length of time this plant has been established, and with due consideration of the influence of turnover, the three conditions may not have been present to a sufficient extent to cause in the workers the symptoms described in the British articles.

An investigation to determine the foregoing should include:

1. Study of dust conditions in asbestos plants.
2. Physical examinations of asbestos workers, correlated with known exposures to dust.

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6. Study of pathological effects of the inhalation of asbestos dust through autopsy of human subjects and by animal experimentation.

The Industrial Health Service of the Metropolitan Life Insurance Company plans to undertake studies A and B, to be correlated later with C, which will be undertaken in some pathological laboratory, probably at Saranac.

This unit of study presented herewith relates only to part A, as it was not feasible to conduct physical examinations at Manville.

The results of this study indicate that the dust exposure of Manville employees falls far below the permissable limit of 10,000,000 particles of silica dust of less than 10 microns in diameter, set by the United States Public Health Service. It is generally considered impossible for particles larger than 10 microns to penetrate the finer air passages into the lung tissue. However, attention is invited to certain reports[1] where asbestos particles measuring as much as 300 microns in length have been found in lung tissue. In the present state of our knowledge, we are not justified in accepting this standard as final, and therefore, proof of the nonexistence of a dust hazard, particularly if we are dealing with alternative number three detailed above. This study does indicate that in the plant in question the probability of asbestosis, so called, is remote.

[illegible], W.E. "Pulmonary Asbestosis". The British Medical Journal, Dec. 3, 1927, p.1022.

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Apparatus and Methods of Sampling:

The impinger[2] and the electric precipitator[3] were both used for the collection of air samples, for dusts, at the breathing levels and in close proximity to the workmen. Both of these forms of apparatus are adapted for this work as they are transportable, easily set up and adjusted for the taking of the air samples at the proper level and are extremely efficient.[1]

The impinger collects the dust by aspirating the air and then impinging it onto a flat surface covered by a liquid in a container. The liquid used was distilled water, containing 50% alcohol to prevent the solution of some of the dusts, particularly any silica which might be present. The impinger was actuated by an electrically driven rotary pump and the rate of air sampled was measured by means of a resistance type of flow meter with an inclined manometer for measuring the pressure difference. Each sample represents the dust collected from a volume of 100 cubic feet of air.

The electric precipitator is designed upon the Cottrell precipitator principle used for recovering dusts and fumes commercially. This principle depends on electrifying the dust particles by making them pass through an electrostatic field[4] and thus causing them to settle out upon a sheet of celluloid. The electrostatic field is set up by means of a transformer operating from the lighting lines on 220 volts, alternating current. Air is drawn through the apparatus by means of a small rotary fan, run by a motor, the quantity being measured by means of a flow meter.

(1) "Comparative Tests of Instruments for Determining Atmospheric Dusts", Public Health Bulletin No. 144, Treasury Department, Washington, D.C.
(2) "Determination of Suspensoids by Alternating-Current Precipitators", Philip Drinker and Robert M. Thomson, Journal of Industrial Hygiene, Vol. VII,

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Samples of dust brushed from beams and pipelines near the ceiling were also secured for chemical analysis. All samples were shipped to the laboratory and the dust counts made according to the adopted methods of the United States Public Health Service.(2) Only particles less than 10 microns in the greatest diameter were counted.

Chemical analyses were made for total (free and combined) silica according to the accepted standard method of Hillebrand.(4)

Description of Plants

There are seven one story brick factory buildings of modern construction. The manufacturing operations were followed through from one department to another, and dust samples were taken wherever there were visual indications of asbestos dust.

Building A1

Fibre Preparation

Asbestos is received in bags and emptied onto the floor where part is mixed with cotton in a picker machine, part is incorporated with other material in a chaser or pug mill, and the remainder separated for large fibres by sifting on large vibrating sieves.

(See photographs #1 and #2 on pages 6 and 7)

(2) Impingement Board of Instruments for Determining Atmospheric Dusts - Public Health Bulletin No. 144, Treasury Department, Washington, D.C.
(4) The Analysis of Silicate and Carbonate Rocks - W.F. Hillebrand, Bulletin 422, U.S. Geological Survey, Washington, D.C.

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Standing Dust of Asbestos and Siliceous Rocks

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All of these operations are performed in an open room and no provision is made for exhausting the generated dust. By far the dustiest operation consists of sieving the asbestos where the fine dust drops to the floor, and the asbestos shredder blows the disintegrated fibres into an open bin.



Sieving Asbestos Shredder

Table A

Sample No.	Location	Dust particles of less than 10 microns in greatest diameter per cubic foot of air
3	Chaser	888,000
4	Willower	1,800,000
5	Picker	1,400,000
9	Disintegrator (Number Grinder machine idle)	456,000
10	Disintegrator (machine operating)	1,000,000

While the amount of dust visible seems to be high, the above table indicates that the particles under 10 microns are not excessive.

Building A

This building houses all of the textile operations from carding to weaving.

The dust samples were taken in the old card room (the new room is not yet in operation), mule and ring spinning rooms, doubler room, and the weave room.

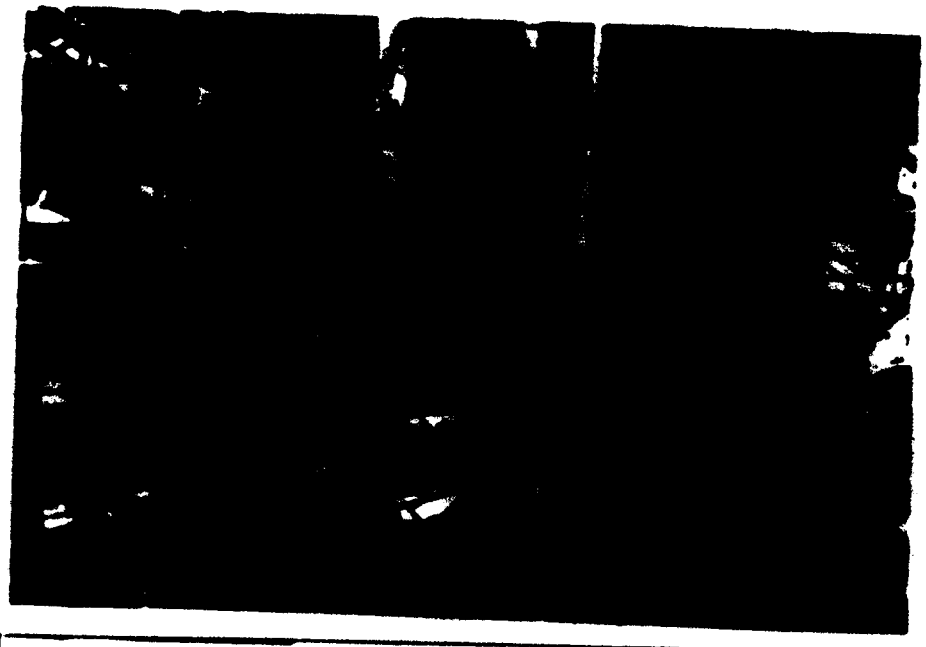
(Photograph #4 on following page)

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The feeding of machines in the card room was done by hand. The material was shoveled from a truck into the hoppers of the carding machines. This room was provided with a humidifying, ventilating and heating system, but it was only used for heating by recirculating the air in the room.

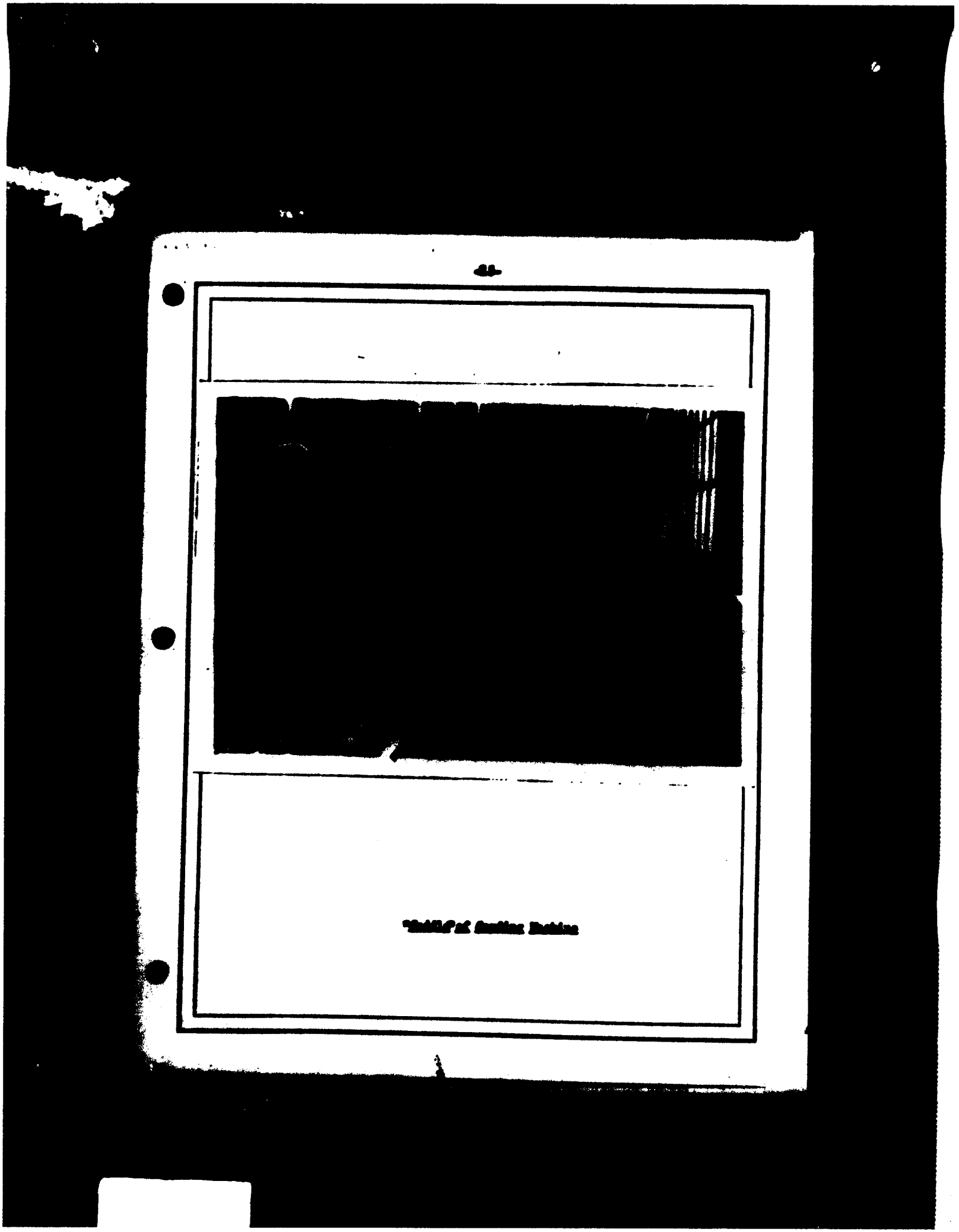


Section of Card Room showing Hoppers



Smiling Sheldon

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Sling psychrometer readings showed an outside reading of 81% relative humidity, while in the card room there was only 58% relative humidity. A corresponding reading in the fibre room taken at the same time was 66% relative humidity.

The card machines were provided with an exhaust system leading from the beater chamber, but in many instances the pipes were either disconnected or blocked with deposits of asbestos fibres. The air velocity readings taken on these exhausts varied from 5,000 to 7,800 linear feet per minute, which, when properly applied, is adequate to remove the asbestos dust. The exhaust system of this plant seems to be in the experimental stage and is not maintained in good repair and operation.

Table #2

CARD ROOM

Sample No.	Location	Particles of less than 10 microns in greatest diameter per cubic foot of air
12	Card room, east aisle	880,000
14	Card room, center aisle	1,000,000
18	Card room, west aisle	1,280,000

However, the above table indicates that the number of particles under 10 microns cannot be considered excessive. The silica content of the material collected from the ceiling beams amounted to 37.08% total silica.

Spinning Rooms

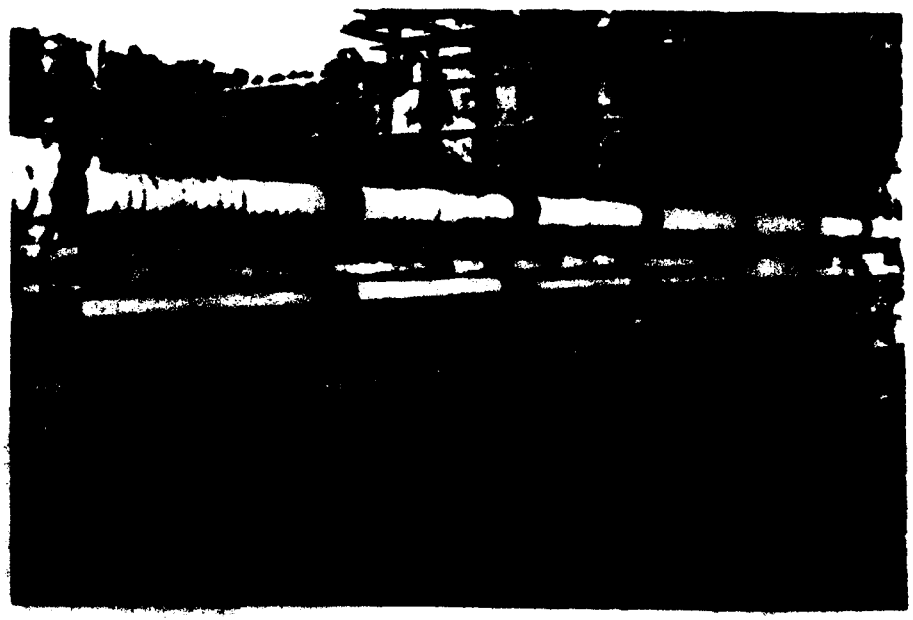
The dust counts of the spinning rooms indicate that the number of particles under 10 microns were lower than found in the card room.

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Table #5

SPINNING ROOMS

Sample No.	Location	Dust particles of less than 10 microns in greatest diameter per cubic foot of air
21	Ring frame spinning	488,000
24	" " "	780,000
25	Mule spinning - between machines	690,000
27	" " - alongside frame	2,800,000



Mule Spinning

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The counts in the spinning rooms are, however, higher than those of the twisting and fermler departments.

Table #4

TWISTER AND FERMLER DUST.

Sample No.	Location	Number of particles of less than 10 microns in greatest diameter per cubic inch of air
31	Shaw Lowell Twister	400,000
33	" " "	380,000
35	Universal winders	300,000
46	Common Twisters #6 and 7	787,000
48	" " "	880,000
41	" " #9 and 10	780,000
43	" " "	1,780,000
39	Wick machines	1,700,000
37	Warp machines - brake lining	894,000
29	" " #1 and 2	400,000

In these departments fine wire is twisted with spun asbestos thread preparatory to weaving for brake band lining. Asbestos paper also is twisted into wicking in these departments.

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Building Basement

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Existing Equipment

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Weaving Room.

From general appearances this room ranks with the card room in regard to the perceptible amount of dust in the air. There are various kinds of looms from those for weaving brake band linings and narrow fabrics up to broad looms used for weaving asbestos cloth. These looms are in close proximity to one another.

No means of humidification is provided. The weavers soak the bobbins of thread in water in order to prevent the thread breaking in the shuttles.

Table #8

WEAVING ROOM

Sample No.	Location	Number of particles of less than 10 microns in greatest diameter per cubic foot of air
49	Listen looms, end of upper loom	58,000
51	No. 5 loom	1,088,000
53	Between looms 720 and 39	884,000
54	Center of room	2,188,000

With an outside relative humidity of 81%, the humidity in the weave room was 66%.

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Section of Beam Room

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Building 5

Fire Brick Department:

The asbestos felt for insulating pipes is fabricated in this department. The material is cut to shape by means of circular and band saws. These saws were unprotected either by safety guards or devices for dust removal, except in two instances of pipe covering saws which were used to cut the pipe covering sections to the desired length. The saws were equipped with a partial exhaust system for removing dust, but this was far from effective.

The dry refractory cement department was located in the south end of this building; while the wet refractory department was located in the basement. Operations in these two departments involve not only the handling of asbestos, but also carborundum, sand, fire clay, and large quantities of silicate of soda solution which were incorporated in the cement.

Table 5A
Fire Brick Department

Sample No.	Location	Number of particles of less than 10 microns in greatest diameter per cubic foot of air
57	Double circular saw	1,970,000
58	Pipe covering saw partially exhausted dust system	330,000
60	Saw-slitting pipe covering	17,880,000
62	Dry refractory cement charging hopper of mixer	1,348,000
63	Dry refractory cement bagging finished product	44,700,000
64	Wet refractory cement charging platform	28,380,000

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It is seen from the above table that by far the greatest dust count was found in this department; counts made at the saw-slitting pipe covering machine and at the dry and wet refractory cement mixers are excessive.

Building E

Sheet Rock Department:

Here insulation material composed of magnesia and asbestos is made. Most of this material is made up into blocks of various sizes and after being molded and baked is cut into shape by circular saws.

Table #7

Sheet Rock Department

Sample No.	Location	Number of particles of less than 10 microns in greatest diameter per cubic foot of air
68	Gang saw #2	4,078,000
70	Planer #2	3,070,000
72	Planer #1	487,000

The operations are similar to those in the fire felt department and consequently some dust arises due to the similarity of operations. These counts in Table #7 cannot be considered excessive.

Other departments visited did not involve the handling of asbestos and therefore no dust samples were taken. However, certain hazards exist in the roofing and asphalt departments where quantities of tar and asphalt are heated. Acrid fumes are given off and penetrate every section of the department; dust arises from handling crushed slate used to coat the roofing paper and from talc used to dust the undersides to prevent sticking. Considerable dust arises from the rag shredder in the paper mill.

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No provisions are made for removing the dusts and fumes from these operations.

General Housekeeping

The handling of raw asbestos outside of the textile work is not controlled in the fibre department, but bags of raw asbestos are emptied and handled on the floors of the fire felt and sheet rock departments. All handling involves hand operations which, in the majority of cases, could be done by means of conveyors. This method would not only eliminate manual labor, but would minimize the dust hazard. Aisles were narrow and frequently obstructed by trucks and piles of material. There is a lack of safety guards on moving belts and wheels. Especially is this true of circular and band saws. No effort is made to prevent workers from expectorating on the floors. Workers are permitted to eat in the work rooms. The provisions for washing are inadequate and no lockers are provided. Drinking water facilities are of an obsolete type, frequently only a pipe connected to a spigot is available.

Clinical Observations

During the progress of these dust estimations, a careful scrutiny was maintained of the men working where the air samples were being taken. There was not detected the symptoms associated with the condition known as asbestosis, namely leaden hued complexion, cough, shortness of breath, wasting and clubbing of the fingers. The majority of workers appeared to be robust, but in the absence of physical examination and further correlation with length of employment, the conclusions drawn from these observations must be limited, as stated in the introductory portion of this report.

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