FILE NAME: US Gypsum (USG)

DATE: August 1933

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Final Report upon the Physical Condition and the
Health of 100 Employees in the U.S.Gypsum Plant at Oakville,
New York,

by the Saranac Laboratory,
August 1933.

PLAINTIFF'S EXHIBIT 1691

The following report is submitted on the study begun on June 19, 1933, of the dust hazard in the Oakfield plant of the U.S.Gypsum Co.

A SURVEY OF THE PLANT was first made and our impressions were fully discussed in the preliminary report of June 27, 1933. Briefly these observations yielded the following points which were regarded as significant:

The mine apparently offered no particular hazard as the ventilation was excellent, the operating methods generated no great amount of dust and the rock and ore were not of a nature known to produce serious pulmonary damage.

The portions of the plant devoted to crushing, calcining and grinding gypsum were quite dusty but owing to the nature of the dust this was not considered hazardous except in one particular. Certain grinding operations were done in Buhr stone mills. The stones themselves being quartz contained high percentages of crystalline silica which is a well-recognized cause of pulmonary fibrosis. Particular stress was laid upon the necessity of protecting the man or men who dress the buhr stones as these persons would be subjected to dangerous quantities of highly injurious dust.

The board and block plants offered no indication of a hazard. Likewise the paper mill, lime plant, power house and shops appeared to be free of danger from dust.

The warehouse did not present such a favorable picture, as many of the operations of mixing and bagging sand plasters involved exposures to considerable quantities of fine silica. The lack of any protection for the operators appeared to expose the workmen to grave hazard. The special operations to which exception was taken were the Bates Packer, #12, and the mixing done by men on the second floor over this machine.

<u>DUST SAMPLING</u> - Representative samples have been taken from various portions of the plant and mine at the points where men might be exposed. The technique employed has been the standard procedure in the United States, using a Greenburg-Smith impinger apparatus for collection of samples and counting particles in a Sedgewick-Rafter cell by light-field illumination at a magnification of 100. In addition counts of the same dust suspensions were made with two other methods of dark field illumination, one at a magnification of 100 and another at 400. By the use of the higher magnification and the dark field illumination smaller particles are visualized than can be detected by the standard procedure.

There follows a tabulation of the various counts:

MINING

Sample No.1 June 19, 1933

Location: 1st.West - 1st.South - 14 Rt.Main South - Rt.Entry.

Operation: Drilling in Gypsum

Time:

First Hole		Second Hole	
Started	10;58	Started	11:15
Finished	10:64	Finished	11:30
	6 minutes		15 minutes

Air Pressure: 40 lbs.

Notes: Electric Drill. Drilled one hole. Started second at time of sample. 2 men mucking within ten feet. Roof 4 ft. Height of impinger 3 ft. 5 to 6 ft. from face. Place is pocketed not very rapid air circulation. Roof dripping - working place is wet.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		1,340,000
Dark "	Plankton	2,660,000
Dark "	Dissecting	9,600,000

Remarks: The standard light field count is approximately 1,350,000 with a silica concentration which does not exceed 2%. Petrographic analysis of the gypsum shows approximately 75% $CaSO_4: 2H_2O$, 10% $CaSO_4$, and 15% $CaCO_3$.

MINING

Sample No. 3 June 20, 1933

Location: Room 27 - 16 Rt. 3rd South - 14 Rt. Main South

Operation: Drilling in Gypsum

Time: Started: 10:37
Finished: 10:52
15 minutes

Air Pressure: 32 lbs.

Notes: Electric drilling in gypsum using 1 1/4" augur drill. Drilled 2 holes. Dead ended - air in from nearby room. No mucking. Roof 3 1/2 ft.

Counts: Number of particles (less than 10µ) per cu.ft. of air.

Light field		1,645,000
Dark "	Plankton	2,650,000
Dark "	Dissecting	5,530,000

Remarks: The standard light field count is approximately 1,650,000 with a silica concentration which does not exceed 2%. Petrographic analysis of the gypsum shows approximately 75% $CaSO_4 : 2H_2O$, 10% $CaSO_4$, and 15% $CaCO_3$

The average standard light field count of Sample No.1 and No.3 is approximately 1,500,000

MINING

Sample No.4 June 20, 1933

Location: 1st.West - 3rd South -14th Rt.Main South - 3rd Entry

Operation: Drilling in Anhydrite

Time: Started 11:19
Finished 11:29
10 minutes

Air Pressure: 22 to 32 lbs.

Notes: Air machine - Auto. feed - 1" Drill. No mucking. dead end. Roof 3'10". Distance from face 3 1/2'.

Counts: Number of particles (less than 10 µ) per cu.ft.of air.

Light	field		10,100,000
Dark	"	Plankton	23,400,000
Dark	"	Dissecting	46,800,000

Remarks: The standard light field count is approximately 10,000,000 with a silica concentration which does not exceed 0.5% silica at the maximum.

MINING

Sample No.5 June 20, 1933

Location: 1st.West - 3rd South -14th Rt.Main South - 3rd Entry

Operation: Drilling in Anhydrite

Time: Started: 11:34
Finished 11:44
10 minutes

Air Pressure: 32 to 22 lbs.

Notes: Air machine - Auto.feed - 1" Drill. No mucking. dead end. Roof 3'10". Back of drill and 9ft.from face.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light	field		11,300,000
Dark	"	Plankton	24,550,000
Dark	"	Dissecting	78,500,000

Remarks: The standard light field count is approximately 11,300,000 with a silica concentration which does not exceed 0.5% silica at the maximum.

The average standard light field count of Sample No. 4 and No.5 is approximately 11,000,000

MINING

Sample No.25 June 22, 1933

Location: 16 R 3rd S - 14 Rt.Main South. Next to Air Drill

Operation: Drilling in the Roof.

Time: Started 2:22
Finished 2:23 1/2
01 1/2 minutes

Air Pressure: 35 lbs.

Notes: Flask held close to head of man operating air drill. Drilling in roof.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		1,930,000,000
Dark "	Plankton	3,900,000,000
Dark "	Dissecting	4,610,000,000

Remarks: The standard light field count is approximately 2,000,000,000 with 45% acid insoluble material. Petrographic analysis shows the material to be approximately 60% limestone and 40% clay.

The average standard light field count of Sample No.2 and Sample No.25 is approximately 1,000,000,000

MINING

Sample No. 24 June 22, 1933

Location:	3rd North - 3rd South, 14 Rt. Main South - In Passageway.
Operation:	Hauling Gypsum
Time:	Started 1:37 Finished 1:52 15 minutes
Air Pressure:	36 to 44 lbs.
Notes:	Mine air - haulage way - near mining operations. Flask 5' above ground over track and close 5' to junction with other drift.
Counts:	Number of particles (less than 10 μ) per cu.ft. of air.

Light field		1,780,000
Dark "	Plankton	3,735,000
Dark "	Dissecting	16,800,000

Remarks: The standard light field count is approximately 2,000,000 with a low silica concentration.

MINING

Sample No.26 June 22, 1933

Location: At foot of #3 shaft. 75 ft. South

Operation: Loading

Time: Started 3:47 1/2
Finished 3:62 1/2
15 minutes

Air Pressure: 35 to 40 lbs.

Notes: Flask 5' above ground near middle of passage way (25'wide) Hoisting going on; empty cars being shifted past set-up. Moderate draft of air through passage.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		2,950,000
Dark "	Plankton	4,220,000
Dark "	Dissecting	31,400,000

Remarks: The standard light field count is approximately 3,000,000 with a low silica concentration.

RAW GYPSUM MILL OPERATIONS

Sample No.6 June 20, 1933

Location: Weighing Floor

Operation: Weighing and Crushing

Time: Started 1:38
Finished 1:58
20 minutes

Air Pressure: 40 to 42 lbs.

Notes: One car per chute (2 chutes) dumped every 40 sec. (300# per car) Sample taken 2 ft. back from corner of chute.

Counts: Number of particles (less than 10 μ) per cu.ft. of air.

Light field		2,350,000
Dark "	Plankton	3,890,000
Dark "	Dissecting	8,430,000

Remarks: The standard light field count is approximately 2,500,000 with low silica concentration.

RAW GYPSUM MILL OPERATIONS

Sample No.7 June 20, 1933

Location: Set-up next to top at elevator at conveyor belt (conveyor belt was carrying gypsum)

Operation: Conveying and storage of crushed gypsum

Time: Started 2:31 2/3
Finished 2:45 2/3
14 minutes

Air Pressure: 40 lbs.

Notes: Sample taken 5 ft. above floor. Sample taken 2 ft. above conveyor belt. Note: Windows open and strong draft across floor.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		4,280,000
Dark "	Plankton	7,680,000
Dark "	Dissecting	14,500,000

Remarks: The standard light field count is approximately 4,000,000 with low silica concentration.

RAW GYPSUM MILL OPERATIONS

Sample No.15 June 21, 1933

Location: Near hammer mill, elevator and conveyor in crushing plant.

Operation: Hammer mill operation.

Time: Started 2:17 1/2
Finished 2:27 1/2
10 minutes

Air Pressure: 40 lbs.

Notes: Crushing raw gypsum. Flask 5 ft. above floor; about 12 ft. from and level with point where conveyor empties into crusher. Wall 20 ft.away with 2 open windows; door open in each side wall. Moderate draft through room.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		13,500,000
Dark "	Plankton	25,300,000
Dark "	Dissecting	34,400,000

Remarks: The standard light field count is approximately 13,500,000 with low silica concentration.

CALCINING AND GRINDING CALCINED GYPSUM

Sample No.29 June 23, 1933

Location: Between Calciners (Rotary Kiln)

Operation: Calcining

Time:				
	Started	10:07 1/2		10:12 1/2
	Finished	10:11 1/2		10:15 1/2
		04		03

Total:07 minutes

Air Pressure: 40 lbs.

Notes: Flask 5 1/2' high, 6' from each kiln 20' from furnace end of kiln. Set-up in passageway, 30' from open doors, moderate movement of air. Impinger disk moved down after 1st. run.

Counts: Number of particles (less than 10 μ) per cu.ft.of air.

Light field		1,175,000
Dark "	Plankton	1,417,000
Dark "	Dissecting	No count - bacteria noted.

Remarks: The standard light field count is approximately 1,[illegible]00,000 with low silica concentration.

CALCINING AND GRINDING CALCINED GYPSUM

Sample No. 30 June 23, 1933

Location:	Next to Hummer Screens
Operation:	Hummer Screens
Time:	Started: 10:54 1/4 Finished: 11:00 1/4 06 minutes
Air Pressure:	40 lbs.
Notes:	Flask 4 1/2' high, 1' from machines - 2 operating. Set-up in passageway next to screens. Moderate draft of air past screen conveyors, past flask and out between screens.
Counts:	Flask broken - no count.

CALCINING AND GRINDING CALCINED GYPSUM

Sample No. 31 June 23, 1933

Location:	Between Ball Mills
Operation:	Ball Mill Grinding
Time:	Started: 11:18 Finished 11:27 09 minutes
Air Pressure:	40 lbs.
Notes:	Flask 5' high, 10' from each mill - 20' from end wall having one open window. Moderate movement of air. Floor covered with fine dust; small amount leaking from one mill.
Counts:	Not counted - bacteria noted.

BUHR STONE GRINDING

Sample No. 14 June 21, 1933

Location: Among Buhr Stone Grinders

Operation: Buhr Stone Grinding

Time: Started: 1:36
Finished: 1:46
10 minutes

Air Pressure: 40 lbs.

Notes: Flask set in center of room among Buhr stone grinders; 16 operating and grinding. Flask about 4 1/2 above floor; about 3 ft. above and 3 ft. from opening of grinder. Moderate draft of air across room.

Counts: Number of particles (less than 10 μ) per cu.ft.of air

Light	field		2,482,000
Dark	"	Plankton	4,060,000
Dark	"	Dissecting	10,720,000

Remarks: The standard light field count is approximately 2,500,000 with slightly increased silica concentration - not to exceed 5%

BLOCK PLANT

Sample No. 27 June 23, 1933

Location:	Block Plant - Over Accelerator Grinder
Operation:	Grinding Accelerator.
Time:	Started 9:19 1/6 Finished 9:25 1/6 6 minutes
Air Pressure:	40 lbs.
Notes:	Flask 3' above and 4' over from chute where accelerator dust is being shaken on moving belt covered with gypsum. Set-up 10' from wall (windows closed); slight current of air tends to carry dust away from flask.
Counts:	Number of particles (less than 10 μ) per cu.ft.of air.

Light field		15,550,000
Dark "	Plankton	23,750,000
Dark "	Dissecting	36,000,000

Remarks: The standard light field count is approximately 15,500,000 with a low silica concentration.

BLOCK PLANT

Sample No. 28 June 23, 1933

Location: Block Plant - Hand Mixer

Operation: Hand Mixing Operation. (This operation is more dusty than the machine operation.)

Time: Started: 9:38 1/2
Finished: 9:48 1/2
.10 minutes

Air Pressure: 40-35 lbs.

Notes: Flask 5 1/2' high, 2' from bucket and chute (gypsum and water is fed into bucket 3'x4' thru chute; rotating disk mixes gypsum). Mixer in middle of room 100' wide, door in each side wall open. Fair movement of air from W. Operator stands over mixer, say 20% of time; a mix every 4 min.

Counts: Number of particles (less than 10 µ) per cu.ft.of air.

Light field		4,370,000
Dark "	(Plankton)	6,425,000
Dark "	Dissecting	23,000,000

Remarks: Standard light field count is approximately 5,000,000 with a low silica concentration.

BOARD PLANT

Sample No. 18 June 21, 1933

Location:	Above accelerator grinder in board plant.
Operation:	Guiding accelerator.
Time:	Started: 4.04 1/2 Finished: 4.14 1/2 .10 minutes
Air Pressure:	40 lbs.
Notes:	Flask 5 1/2 ft. above floor and grinder; 5 ft. over from grinder. Not so well ventilated; nearest window about 30 ft.
Counts:	Number of particles (less than 10 µ) per cu.ft.of air.

Light field		12,480,000
Dark "	Plankton	20,500,000
Dark "	Dissecting	35,100,000

Remarks: The standard light field count is approximately 12,500,000 with a low silica concentration.

BOARD PLANT

Sample No. 23 June 22, 1933

Location: Middle of Board Plant.

Operation: General Air (near discharge from kiln)

Time: Started: 11:20
Finished: 11:40
.20 minutes

Air Pressure: 40 lbs.

Notes: Flask set at N end of kiln of #2 board machine; 5 1/4 ft. above floor, in center of room (300' x100'). Windows open on E side, doors on W side (100' wide).

Counts: Number of particles (less than 10 μ) per cu.ft. of air.

Light field			503,000
Dark	"	Plankton	800,000
Dark	"	Dissecting	3,450,000

Remarks: The standard light field count is approximately 500,000, with a low silica concentration.

WAREHOUSE

Sample No. 8. June 20, 1933

Location: Set-up next to #6 machine packing cement-plaster. Level with operators shoulders and close to him.

Operation: Packing gypsum plaster in paper bags on machine provided with exhaust system.

Time: Started: 3:15
Finished: 3:19 2/3
.04 2/3 minutes

Air Pressure: 40 lbs.

Notes: Machine #6: This machine has exhaust system. Fan over doorway 15 ft. from machine was operating, blowing air from outside, across operator, toward machine. Contains gypsum, seisel and retarder. No sanded plaster being made at present time.

Counts: Number of [redacted] particles (less than 10 μ) per cu.ft. of air:

Light field		11,250,000
Dark "	Plankton	16,950,000
Dark "	Dissecting	31,500,000

Remarks: The standard light field count is approximately 11,500,000 with a low silica concentration.

WAREHOUSE

Sample No. 10. June 20, 1933

Location: Set-up next to #6 machine. Packing jute bags with gypsum.

Operation: Packing gypsum plaster in jute bags on machine provided with exhaust system.

Time: Started: 4:33
Finished: 4:43
10 minutes

Air Pressure: 40 lbs.

Notes: Machine No. 6 has exhaust system. Strong wind blowing outside and through hall past machine.
No sanded plaster being made at present time.

Counts: Number of [redacted] particles (less than 10 μ)per cu.ft.of air:

Light field		6,350,000
Dark "	Plankton	9,600,000
Dark "	Dissecting	63,200,000

Remarks: The standard light field count is approximately 6,500,000 with a low silica concentration.

WAREHOUSE

Sample No. 9 June 20, 1933

Location:	Set-up next to #7 machine packing wood-fiber plaster. Close to operator as for sample #8.
Operation:	Packing wood-fiber plaster in paper bags on machine provided with exhaust system.
Time:	Started: 3:33 Finished: 3:43 10 minutes
Air Pressure:	40 lbs.
Notes:	Fan over doorway 15 ft. from machine was operating, blowing air from outside across operator toward machine. Contains gypsum, wood fiber, retarder and small amount of lime (25# per ten). No sanded plaster being made at present time.
Counts:	Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field		15,150,000
Dark "	Plankton	29,500,000
Dark "	Dissecting	80,400,000

Remarks: The standard light field count is approximately 15,000,000 with a low silica concentration.

WAREHOUSE

Sample No. 16. June 21, 1933

Location: Next to #9 Mixer. Cement-Plaster.

Operation: Mixing gypsum plaster.

Time: Started: 2:50 1/2
Finished: 2:54 3/4
.04 1/4 minutes

Air Pressure: 40 lbs.

Notes: Flask 2 ft. over and 1 ft. above opening where mixer is fed; flask is 5 1/2 ft. above floor, 20 ft. from side wall and open windows. On West side of building. Mixer being fed gypsum, seisel, retarder. Liquid in flask foamed considerably limiting duration of collection. No air protection on machine.

Counts: Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field		15,900,000
Dark "	Plankton	35,700,000
Dark "	Dissecting	55,625,000

Remarks: The standard light field count is approximately 16,000,000 with a low silica concentration.

WAREHOUSE

Sample No. 20 June 22, 1933

Location: Next to #12 Machine packing sanded plaster.

Operation: Packing Sanded plaster.

Time: Started: 9: 27 1/2
Finished: 9: 29 1/2
2 minutes

Air Pressure: 40 lbs.

Notes: No exhaust on machine. Flask 1 ft. from operator's head; at shoulder level. Operator 10 ft. from wall and open door.

Counts: Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field			28,175,000
Dark	"	Plankton	74,900,000
Dark	"	Dissecting	48,800,000

Remarks: The standard light field count (average for samples 17 and 20) is approximately 30,500,000 with a low silica concentration.

WAREHOUSE

Sample No. 17 June 21, 1933

Location: Next to #7 Mixer - Wood fiber

Operation: Mixing wood fiber plaster

Time: Started: 3:33
Finished: 3:37 1/3
4 1/3 minutes

Air Pressure: 40 lbs.

Notes: Flask 1 1/2 ft. above, 2 ft. over from feed opening in machine; 5 1/2 ft. above floor; 20 ft. from side wall and open windows; next to #7. Part of time flask held close to feed opening, where operator stands. No protection on machine.

Counts: Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field			32,400,000
Dark	"	Plankton	74,800,000
Dark	"	Dissecting	125,000,000

Remarks: The standard light field count (average for samples 17 and 20) is approximately 30,500,000 with a low silica concentration.

WAREHOUSE

Sample No. 19 — June 22, 1933

Location: Next to #12 Machine packing sanded plaster.

Operation: Packing sanded plaster. Machine not provided with exhaust system.

Time:
Started 9:19 1/2
Finished 9:21 1/4
1 3/4 minutes (flask foamed)

Air Pressure: 40 lbs.

Notes: No exhaust on machine. Flask 1 ft. from operator's head; at shoulder level. Operator 10 ft. from wall and open door.

Counts: Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field			44,200,000
Dark	"	Plankton	66,300,000
Dark	"	Dissecting	73,000,000

Remarks: The standard light field count is approximately 44,000,000 with an appreciable concentration of silica.
Note: See analysis of sand under Sand Plant. The formula for this plaster contains 600# of coarse sand and 700# of fine sand per 1927# of mix.

WAREHOUSE

Sample No. 22 June 22, 1933

Location: Next to #12 Mixer - Sanded Plaster

Operation: Mixing sanded plaster

Time: Started: 9:50 1/2
Finished: 9:52 1/2
2 minutes

Air Pressure: 40 lbs.

Notes: Same as #21 except flask held 5 or 6 ft. from machine in different positions.

Counts: Number of [redacted] particles (less than 10 μ) per cu. ft. of air:

Light field		146,000,000
Dark "	Plankton	258,000,000
Dark "	Dissecting	3,318,000,000

Remarks: The standard light field count is approximately 146,000,000 with a very appreciable concentration of silica.
Note: A sample taken directly opposite the sand discharge chute showed a count of 11,000,000,000.
See analysis of sand under sand plant.
The formula for this plaster contains 600# coarse sand and 700# of fine sand per 1927# of mix.

WAREHOUSE

Sample No. 21 June 22, 1933

Location: Next to #12 Mixer - Sanded Plaster

Operation: Mixing Sanded Plaster.

Time: Start: 9:41
Finish 9:42
1 minute (Foam over)

Air Pressure: 40 lbs.

Notes: Flask held over feed opening where operator stands 1 ft. above opening; next to sand chute. Wall and 3 open windows 12 feet away. Some circulation of air near machine but not very good.

Counts: Number of particles (less than 10 μ) per cubic ft. of air:

Light field		11,220,000,000
Dark "	Plankton	24,700,000,000
Dark "	Dissecting	9,500,000,000

Remarks: The standard light field count is approximately 11,000,000,000 with a very appreciable concentration of silica.

Note: This sample was taken directly opposite the sand discharge chute and represents the highest possible exposure at this location. See analysis of sand under sand plant. The formula for this plaster contains 600# coarse sand and 700# of fine sand per 1927# of mix.

SAND PLANT

Sample No. 12 June 22, 1933

Location:	Furnace Room - Sand Drier Plant
Operation:	Furnace Room
Time:	Started - 10:22 Finished- 10:35 13 minutes
Air Pressure:	40 lbs.
Notes:	Flask set 7' from furnace, 5' from outside door, 5 1/2' above floor. Both doors in wall 12' from furnace open; good current of air in front of furnace.
Counts:	Number of particles (less than 10 μ) per cu. ft. of air:

Light Field	2,960,000
Dark " Plankton	8,730,000
Dark " Dissecting	26,500,000

Remarks: The standard light field count is approximately 3,000,000. Chemical analysis of the coarse sand is as follows:

Loss on ignition	27.21
Total SiO_2	32.13
Al_2O_3, P_2O_5, TiO_2	5.74
Fe_2O_3	1.80
Ca O	21.31
Mg O	9.19
	97.38

Free SiO_2 (as quartz) determined chemically is 26%.
Petrographic analysis discloses this sand to be 75% calcite and 25% free quartz.

SAND PLANT

Sample No. 11 June 21, 1933

Location: Near Roller crusher sand plant.

Operation: Roller crusher room

Time: Started: 9:56 3/4
Finished: 9:60 3/4
4 minutes

Air Pressure: 40 lbs.

Notes: Flask set 12 ft. from crusher, 15 ft. from passage, 5 1/2 ft. above floor, in path at air stream from crusher out thru door.
Note: First sample was discarded because 25 cc. liquid carried over.
Another sample also taken. See 11A.

Counts: Number of particles (less than 10 μ) per cu. ft. of air:

Light field		227,000,000
Dark "	Plankton	292,000,000
Dark "	Dissecting	2,600,000,000

Remarks: The average count (standard light field) for samples 11 and 11A is approximately 237,000,000. Chemical analysis of the fine sand is as follows:

Loss on ignition	12.96
$Si\ O_2$ (silica)	59.21
Al_2O_3, P_2O_5, TiO_2	7.53
Fe_2O_3	2.00
CaO	11.57
MgO	4.61

Free silica (as quartz) determined chemically is 52%.
Petrographic analysis discloses this sand to be 50% calcite and 50% free quartz.

SAND PLANT

Sample No. 11A June 22, 1933

Location: Near roller crusher sand plant.

Operation: Roller crusher room.

Time: Started 10:13
Finished 10:16 1/4
3 1/4 minutes.

Air Pressure: 40 lbs.

Notes: 12 ft. from crusher, 8 ft. from door in path of air stream from crusher out through door.

Counts: Number of particles (less than 10 µ) per cu. ft. of air:

Light field			246,000,000
Dark	"	Plankton	378,000,000
Dark	"	Dissecting	3,320,000,000

Remarks: The average count (standard light field) for samples 11 and 11A is approximately 237,000,000. See Sample 11 for Chemical analysis.

MISCELLANEOUS OPERATIONS

Sample No. 13 June 21, 1933

Location: Next to man chipping Buhr stones

Operation: Buhr stone trimming

Time: Started 1:47 3/4
Finished 1:57 3/4
10 minutes

Air Pressure: 40 lbs.

Notes: Flask set 3 1/2 ft. above floor; 1 1/2 ft. above and 2 ft. over from chipping hammer. Fan in wall 18 ft. away drives current of air past man and out windows 12 ft. away. Air-operated chipping hammer. Man brushes off Buhr stones occasionally (every 2 min. or so) raising some dust.

Counts: Number of particles (less than 10 μ) per cu. ft. of air:

Light field		6,520,000
Dark "	Plankton	11,950,000
Dark "	Dissecting	18,400,000

Remarks: The standard light field count is approximately 6,500,000 and the dust is practically pure silica.

SUMMARY OF ANALYSES OF DUST FROM GYPSUM PLANT

July 11, 1933

Percentage of Acid Insoluble Material

Over #12 Mixer	45.3%
" # 7 "	2.9%
" # 4 "	2.0%
Gypsum Dust (for dusting animals)	2.0%
Buhr Stone	96.8%
Ash or Roof Rock	
White	0.0%
Dark	53.2%
Grey	40.7%

DISCUSSION OF THE CHARACTER OF THE DUST AND ITS CONCENTRATION IN VARIOUS PORTIONS OF THE PLANT. Obviously the proof of the development of silicosis or any other form of pneumonokoniosis must rest upon the presence in the industrial atmosphere of a sufficient quantity of silica particles or other dusts known to produce permanent injury to the lungs in such a state of fineness that they can be inhaled. The foregoing tables report in detail the results of dust sampling in representative locations throughout the plant and in addition there are appended, in appropiate places, analyses of the various types of material encountered.

MINING. In the mining operations men are engaged in work upon three prinicipal types of rock, of which gypsum constitutes the greatest quantity. Chemical analysis of representative samples of gypsum shows that the total acid insoluble material varies from a trace to about 20%. Petrographic analysis of this rock indicates that it contains approximately 75.0% gypsum ($CaSO_4$ $2H_2O$), 10.0% anhydrite ($CaSO_4$), and 15.0% calcite ($CaCO_3$). Fortunately there is not enough silica present in the native gypsum to constitute a hazard unless the concentrations of the total particles in the air are in excess of 250,000,000 particles per cubic foot. The actual dust concentration produced by drilling gypsum rock is less than 2,000,000 particles per cubic foot of air. Previous studies have failed to indicate that there is any hazard associated with calcium carbonate dust. Consequently it is is evident that there is nothing associated with the mining of ordinary gypsum which could be considered responsible for the production of silicosis.

The second most important rock encountered underground is termed anhydrite and represents a native anhydrous calcium sulphate.

This material shows from a trace to 0.5% acid insoluble material. Since this rock is harder than gypsum an air operated percussion drill is required in the drilling operation and higher dust counts result. Average counts obtained during this operation showed 11,000,000 particles per cubic foot of air. Since the silica content of this rock is negligible, the dust produced in drilling it can not be regarded as capable of producing silicosis until concentrations of nearly 1,000,000,000 particles per cubic foot of air are created.

The third and least extensive rock work undertaken underground involves the removal of roof rock from the haulage ways. This roof rock is called ash and shows, on chemical analysis, from 41.0% to 58.0% of acid insoluble material. Petrographic analysis of this material indicates that it is an argillaceous limestone containing about 60% calcite and 40% clay. Clay contains aluminum silicate and therefore it can not be said that drilling the roof rock presents no dust hazard since certain silicates are known to produce pulmonary fibrosis. The operation of removing this roof rock from the haulage ways is performed with a jack hammer drill and the dust concentrations produced are very large. A count made near the head of an operator during a typical operation disclosed 1,930,000,000 particles per cubic foot of air. Obviously, this work is theoretically the most hazardous from the pneumonokoniosis standpoint of all the tasks performed underground, and yet it can not be regarded as a serious hazard for several reasons. The work is not very extensive, it is intermittent in character, it involves only a few workmen, and the dust produced is not free silica but contains less than 40% aluminum silicate.

Dust samples secured in the haulage ways near the mining territory and near the loading shaft indicate that the amount of dust suspended in the general mine air is not excessive.

RAW GYPSUM PLANT. Men engaged in this portion of the plant are exposed only to the dust of raw gypsum. Samples were taken on the weighing floor, over the conveyors on the upper floor, and near the hammer mill. These samples were all taken during regular operations and the counts obtained indicate that there is not an excessive quantity of dust present throughout the greater part of this plant. Near the hammer mill the concentration was found to be 13,500,000 particles per cubic foot. This amount of gypsum dust is probably not dangerous, but it is advisable to install equipment which will reduce the concentration to less than 10,000,000 per cub ic foot.

CALCINING AND GRINDING PLANT. In general the dust created in this plant is calcined gypsum. Chemical analysis of this dust shows that the acid insoluble material does not exceed 2.0%. Petrographic analysis discloses approximately 70.0% hemihydrate ($CaSO_4$ 1/2 H_2O),5% dead burned gypsum, 15.0% calcite ($CaCO_3$), and 10% anhydrite ($CaSO_4$).

There are two sources from which a siliceous contamination may occur in this plant, namely: the refractory material lining the kiln and the buhr stones used in one portion of the grinding operation. Neither of these sources of silica can be regarded as creating a real hazard for the following reasons: both the refractory material and the buhr stones are well enclosed, the actual amount of siliceous contamination added to the gypsum is very small (less than 1.0%), and the dust concentrations around these operations is not excessive. Samples taken between the calciners and over the buhr stone mills during normal operation show less than 1,500,000 and 2,500,000 particles per cubic foot of air respectively. Samples were also taken near the hammer screens and near the ball mills but due to bacterial contamination it will be necessary to obtain new samples from these locations. One individual operation, that of trimming the buhr stones, will be considered later.

BLOCK PLANT. The dust created in the block plant is largely calcined gypsum. A small amount of wood fiber is also suspended in the air but this is not regarded as significant. A sample recovered near the head of an operator using a hand mixer showed less than 5,000,000 particles per cubic foot of air. This concentration is low and would be permissable under any conditions. The grinding of accelerator (gypsum blocks) produces concentrations of approximately 15,500,000 particles per cubic foot of air and though the dust is not considered hazardous, equipment should be provided which will reduce this concentration to less than 10,000,000 particles per cubic foot of air.

BOARD PLANT. The dust created in the board plant is identical with that produced in the block plant and consists almost entirely of gypsum. A sample taken near the center of the plant shows only about 500,000 particles per cubic foot of air. This concentration is lower than that found on most city streets. The grinding of accelerator (gypsum blocks) produces concentrations of approximately 12,500,000 particles per cubic foot of air. This operation might be improved to reduce the concentration of dust, though it is not hazardous in either composition or quantity. At the southern end of the board plant is a machine for polishing veneered boards. Samples were not obtained near the operator of this machine, but it was noted that no sand, flint, or quartz papers are used in this process. Aloxite paper is being used at the present time and its continued use is recommended. Research in this laboratory has shown aloxite to be relatively incapable of producing fibrosis, while the introduction of silica abrasives would create a very significant hazard.

WAREHOUSE. There are a great variety of dusts present in the air of the warehouse. The largest single constituent of these various dusts is calcined gypsum; the second largest, is a fine sand. Chemical analysis of the fine sand shows that it contains 59% to 60% silica, and that 52.0% of the sand is free quartz. Petrographic analysis discloses this sand to be approximately 50.0% calcite and 50.0% free quartz. Other constituents present in the air borne dust are, coarse sand, wood fiber, jute fiber, and organic materials used in the retarder. Occasionally pure quartz sand, asbestos, and talc are used in plasters and a certain amount of dust from these materials must enter the atmosphere. The coarse sand shows 32.0% silica on chemical analysis and 26.0% of the sand exists as quartz. Petrographic analysis discloses this coarse sand to be 75.0% calcite and 25.0% free quartz.

Dust collected from the rafters over the #12 mixer at the southern end of the warehouse shows about 45.0% acid insoluble material. Similar dust from over #7 mixer shows 3.0% acid insoluble material, while the dust above #4 mixer shows only 2.0% acid insoluble material. The largest part of the sanded plasters are made at the #12 machine. Sanded plaster may contain as much as 65.0% sand and since the sand contains from 25.0% to 50.0% quartz, the dust in the air may contain from 16.0% to 33.0% quartz. Obviously, the dust created in the making of sanded plaster must be regarded as hazardous but this hazard appears to be fairly well localized to the #12 machine.

Samples obtained during the packing of ordinary cement plaster in both paper and jute bags on machines provided with exhaust ventilation showed from 6,000,000 to 11,000,000 particles per cubic foot of air. Another sample taken near the same machines during the packing of wood fiber plaster showed 15,000,000 particles per cubic foot of air. These concentrations represent about the highest permissible counts and it would appear advisable to improve the exhaust system so that not more than 10,000,000 particles per cubic foot of air reached the head of the operator. In general, however, the packing of gypsum or wood fiber plaster on the machines protected with exhaust ventilation can not be considered hazardous.

Samples taken on the second floor of the warehouse during the mixing of ordinary gypsum plaster or wood fiber plaster showed counts from 16,000,000 to 32,000,000 particles per cubic foot of air. Though the dust created in this operation does not contain significant quantities of silica, the concentrations are two or three times greater than the usual standards permit.

Samples secured near the #12 Bates Packer (which has no exhaust system) during the packing of sanded plaster showed from 28,000,000 to 44,000,000 particles per cubic foot of air. Since as much as one third of this dust can be pure quartz, it is obvious that men packing sanded plaster breath an atmosphere containing from 5,000,000 to 15,000,000 quartz particles per cubic foot of air. This is considered to be a definitely hazardous concentration of harmful dust. The concentration of quartz particles per cubic foot of air ought" never to exceed 5,000,000 and even this number may not be safe. For this reason it is urgently recommended that the operations involved in the manufacture of sanded plasters be given special consideration.

A sample taken near the #12 mixer during the mixing of sanded plaster showed 146,000,000 particles per cubic foot of air. This concentration is excessive and hazardous and should be reduced to within 10,000,000 particles. A sample recovered near the point where fine sand is delivered to the mixer showed more than 11,000,000,000 particles suspended in a cubic foot of air.

The mixing and packing of sanded plasters should be done in a section of the warehouse which is separately enclosed and special equipment should be installed to reduce the amount of dust suspended in the air to the minimum.

SAND PLANT. The dust created in the sand plant is all produced by the processing of the sands whose analysis have been given in the section dealing with the warehouse. The silica content varies from 32.0% to 60.0% and the amount of free quartz varies from 26.0% to 52.0%. A sample taken in front of the furnace showed approximately 3,000,000 particles per cubic foot of air. Though the dust is definitely dangerous, the concentration is not high and the hazard can not be very great in this position which the operator of the sand plant occupies a considerable portion of his time. A sample taken in the center of the roller crusher room showed the excessive concentration of 227,000,000 particles per cubic foot of air. Every effort should be made to keep the amount of dust in the air of this plant to a minimum which should never exceed 10,000,000 particles per cubic foot for in these concentrations this dust is dangerous.

BUHR STONE TRIMMING. Chemical analysis of the buhr stones has shown that they contain 97.0% acid insoluble material and petrographic analysis indicates that the material is practically pure normal quartz. A sample obtained near the head of the man engaged in trimming these stones with an air hammer showed 6,500,000 particles per cubic foot of air. This concentration is near the maximum permissible for pure quartz dust and is to be regarded as hazardous. It would appear advisable to move this operation to a separate room or to equip the operator with special exhaust ventilation.

It is recommended that the following men be required to wear special respirators until such time as the dust concentrations in which they are working are reduced to within the recommended limits.

1. Miners drilling roof rock or ash.
2. Men mixing, packing, or carting sanded plasters in the warehouse.
3. All employees in the sand plant.
4. Men trimming buhr stones.

By the methods employed it would appear that men are being exposed to excessive concentrations of dust. Since it is known that severe pulmonary damage is produced by silica, and if it is assumed that gypsum or calcium sulphate is relatively harmless it becomes essential to ascertain the relative proportions of these two substances in the atmospheric dust of this plant. It was assumed that this could be accomplished by making a preliminary count of the total dust particles in the air samples, then dissolving the calcium sulphate by treatment with acid and again counting the remaining silica particles which would not be attacked by acid. For technical reasons this procedure has proven unsatisfactory and it is deemed advisable to make a special study of this problem in another visit to the plant which will be made in the immediate future. It is proposed to employ an Owens-Jet Dust Counting Apparatus which will permit the collection of dust samples on cover glasses in such form that by direct microscopic examination the relationship of various particles can be observed and their petrographic characteristics can be determined. By the use of this apparatus it will be possible to determine not only the relative proportions of gypsum and silica in the atmospheric dust but to learn whether the gypsum may not have been responsible for the formation of aggregates of silica particles too large to be inhaled. The subsequent sections dealing with the condition of the workmen will disclose there is no demonstrable silicosis among them, and some explanation is necessary in view of the high concentrations of silica to which they have been exposed.

PHYSICAL EXAMINATIONS - were made on 101 men employed for maximum periods in various portions of the plant. With two exceptions there was no evidence of disease of the lungs and in the two cases the condition was apparently not particularly serious. One man, Bert Werth, had been employed for 10 years in the block plant. He had a lateral curvature of the spine and a few changes in breath sounds with rales in the top of his left lung. His x-ray picture showed changes which could be interpreted as healed tuberculosis. Another man, Arthur Monette, was employed for nine years as a mason and brick-layer. While he worked in all departments he spent most of his time in the power plant furnace and repairing the calciners. "Squeaks," both expiratory and inspiratory, suggestive of asthma, were discovered on two separate examinations. His x-ray picture showed a third degree of interstitial fibrosis but none of the nodulation characteristic of fully developed silicosis. Otherwise the physical examinations of the chests in these men were quite negative.

In 76 of the 101 cases cloudiness of the sinuses in the head were noted on transillumination. In the absence of a definite history of sinus disease and without a thorough x-ray study of this condition a definite diagnosis of sinusitis could not be made. An equally high incidence of this condition has been observed in other dusty occupations.

Two cases of heart disease and one of hyperthyroidism were discovered but neither of these could in any way be caused by inhalation of dust. In addition there were numerous cases with bad teeth, tonsils and nasal conditions which were reported to the men thru Mr. Daniels with the recommendation that they be given proper medical or dental attention.

ROENTGENOLOGICAL EXAMINATION showed some evidence of abnormality in the lungs of 88 of the group of 101, but in none were the changes very pronounced. No case could be diagnosed as silicotic.

The changes observed could not be correlated with the type or duration of occupational exposure. For purposes of classification the men were grouped according to the theoretical hazard of their occupation as follows:

Table I.

Occupation	Number in Group
Buhr Stone Dressers	2
Warehouse only.	6
Warehouse plus Other Departments.	9
Board Plant	19
Miscellaneous Occupations with Occasional Work in Warehouse.	13
Miscellaneous Occupations with No Warehouse Work	19
Block Plant	10
Mining Only	22
Laboratory Tester	1

Two main types of change, which might be due to dust, were observed in the roentgenograms, (1) an increase in prominence of the normal linear shadows of the lung and (2) a diffuse haziness throughout the central portions of the lung fields. In the table following, the first change is designated as "F" and the second as "P". The appended numerals indicate the intensity of these changes. Their significance will be discussed below.

Table II.

Summary of Roentgenological Findings

Occupation	No. in Group	Pneumonokoniosis							Tuberculosis	
		0	P_1	P_2	P_3	F_1	F_2	F_3	Healed Childhood	Healed Adult
Miners	22	1	10	0	0	8	3	0	3	2
Block Plant Only	10	1	3	0	0	0	6	0	1	0
Miscellaneous with Occasional Ware-										

Table II. (Continued)

Occupation	No. in Group	Pneumonokoniosis O	P_1	P_2	P_3	F_1	F_2	F_3	Tuberculosis Healed Childhood	Healed Adult
Board Plant Only	19	5	2	2	0	8	2	0	4	1
Warehouse Only	6	2	1	0	0	2	1	0	1	0
Warehouse plus some work elsewhere	9	2	1	0	0	2	4	0	3	0
Miscellaneous Occupation with no Warehouse	19	1	1	0	0	8	9	0	3	0
Buhr Stone Dressing	2	0	0	0	0	0	2	0	1	1
Laboratory	1	0	1	0	0	0	0	0	0	0

On analysing these findings it appears that the "P" classification indicating a diffuse type of interstitial (?) reaction occurs most frequently in men exposed to pure gypsum dust. The presence of this type of reaction in the different occupational groups is summarized as follows:

Table III

Mining Only	45%
Block Plant Only	30%
Miscellaneous Occupations with Occasional Work in Warehouse	23%
Board Plant	17%
Warehouse Only	16%
Warehouse with Miscellaneous Occupations Elsewhere	11%
Miscellaneous occupations with no Warehouse Exposure	5%
Buhr Stone Dressing	0

The significance of this change has not been definitely ascertained for lack of autopsy material upon which to base an interpretation. Individuals do not always show a degree of reaction corresponding to the duration of their employment, but among the group of miners 38% of those employed for 9 to 12 years show it while after mining from 13 to 25 years 55% of the men have x-ray changes of this type. In the block plant group the corresponding percentages for the same employment periods were 20 and 40% respectively, while in the "Occasional Warehouse Employment Group" none showed it under 13 years of exposure. In two miners exposed for 9 and 21 years respectively this change was complicated by some emphysema. For these reasons we are inclined to associate this change with an exposure to gypsum dust, but we have no clear understanding of the underlying pathological condition.

The other type of roentgenological change encountered which is labeled "F" consists of an accentuation of the linear shadows cast by the bronchi and blood vessels. This change could not be correlated with the type of dust to which the men in the various groups were exposed. It occurred in both the buhr stone dressers who must have been exposed to considerable quantities of fine silica but only two-thirds of the x-rays of Warehouse men displayed it. John Smith, who had worked for 10 years on the Bates Packer where he would theoretically inhale large amounts of silica had a normal chest picture. This warehouse group of only 6 men is probably too small and the duration of their exposures is too limited (all under 12 years) to permit statistical analysis. Possibly if the group were larger the figures would have proved more enlightening. It is still our belief that if silicosis should appear after further exposure it would occur in men exhibiting an "F" type of roentgenogram.

One man, Monette, a mason and bricklayer for 9 years, as already mentioned, showed a change classified as F_3. In his case the accentuation of the linear markings was accompanied by a suggestion of beading along the trunks such as occurs in early silicosis. This man may have inhaled considerable quantities of silica in his work of repairing furnaces and calciners which are presumably lined with refractory silica brick. However, even he could not be called a case of fully developed silicosis.

Tuberculosis was always manifested as healed lesions in the roentgenograms. The changes were of two types, (1) the "childhood type" which represents the first contact of the body with the tubercle bacillus and (2) the "adult type" which occurs when the body is again infected with this germ. The childhood reaction consists of one or more isolated nodules of tuberculosis somewhere in the lung and another focus in a lymph node situated at the root of the lung. Such nodules of infection tend to heal with a deposition of lime salts which renders them easily visible in an x-ray film. In the gypsum workers these nodules healed with an excessive deposition of lime so that they were unusually large. The incidence of such infectious lesions was no greater than that in any group of individuals.

The other type of tuberculous change, the "adult lesion", generally occurs in the upper portion of the lung. It also normally tends to heal but occasionally it spreads and gives rise to widespread manifest clinical tuberculosis with symptoms and possibly fatal termination. Five or possibly seven in this series of gypsum workers showed evidence of a previous adult type of tuberculosis, but in every case the lesion had completely healed without exhibiting the slightest tendency to spread. If a corresponding number of men exposed to pure silica dust were in question, it is safe to assume that some of these adult types and possibly even the childhood types of tuberculosis would have shown evidence of spread and progression.

Following is a list of the individual workmen, grouped according to occupation, together with their x-ray findings.

10 Block Plant Only, 7 to 21 Years

Employed	Name	Case No.	X-Ray
7 yrs.	Frank Manke	46	F_2
8 yrs.	A. Ferris	48	F_2
11 "	C. Brown	41	F_2
12 "	F. Waterstreet	23	P_1
13 "	B. Newton	45	F_2
14 "	Fred. Manke	47	F_2
15 "	Al. Rumsey	22	P_1
16 "	M. Olmstead	42	F_2
19 "	Carl Lutz	19	P_1
21 "	F. Urtel	43	0 ? Primary Complex

2 Buhr Stone Dressers

Employed	Name	Case No.	X-Ray
9 "	H. Whitney	38 (6 yrs.elsewhere)	F_2 Primary Complex,Rt
11 "part) time)	C. Rinehart	40	F_2 Fibrosis Lt ?Tuberculosis

1 Laboratory Tester

Employed	Name	Case No.	X-Ray
10 "	Cummings	101	P_1

22 Miners

Employed	Name	Case No.	X-Ray
9 "	E. Cassiano	77	P_1
9 "	C. Nelson (Brusher)	76	P_1 and emphysema
9 "	J. Jerome (Loader Hard Coal)	61	F_2
10 "	A. Domaogoila	62	F_2 calcified apices
11 "	S. Scopano (Pig Iron Loader 2 years)	57	F_1

22 Miners (Continued)

Employed	Name	Case No.	X-Ray	
12 years	J. Malta	78	P_1	
12 "	D. Paolucci	74	P_1	Primary complex, Lt.
12 "	A. Paolucci	63	F_1	
12 "	A. Frigoni	64	F_1	Primary complex, Rt.
12 "	N. Paolucci	67	F_1	Large Heart
12 "	A. Ferrari	68	F_2	
12 "	D. DeAngelis	69	P_1	Primary complex, Rt.
12 "	S. Ianni	70	F_1	
13 #	F. Yanik	71	P_1	Large Heart
16 "	P. Taddei	80	P_1	
17 "	E. Capone	73	0	
17 "	S. Hallat	100	P_1	Calcification Rt. Apex
18 "	G. Cafero	66	F_1	
19 "	J. Callanan	75	F_1	
21 "	J. Balonek	79	P_1	Emphysema
24 "	R. Cure	24	F_1	
25 "	P. Malta	96	P_1	

19 Board Plant Only

5 "	L. Heidenrich	52	F_1	
7 "	J. Woods	54	F_1	Primary complex, Rt. and Lt.
8 "	B. Werth (2 yrs. outside)	53	F_1	Ditto
8 "	E. Green	25	F_2	Ditto
8 "	Wm. Adams	56	0	
10 "	Winkstern	37	0	
10 "	S. Davidson	35	P_2	Calcified both apices

19 Board Plant Only (Continued)

Employed	Name	Case No.	X-Ray	
10 years	T. Perfitt	34	0	
10 "	E. Bumstead	32	F_1	Primary complex, Lt.
10 "	I. Davis	3	F_1	"
10 "	S. Davis	2	F_1	
11 "	M. Allen	30	F_2	
12 "	R. Harris	26	0	
12 "	W. Greene	36	0	
13 "	F. Taber	31	P_2	
14 "	V. Seaburg	24	F_1	
15 "	W. Allen	33	P_1	
16 "	R. Allen	29	P_1	
22 "	S. Dick	27	F_1	

6 Warehouse Only

5 "	R. Valena	14	F_1	
6 "	Fred Bernard	11	0	
6 "	Wm. Shepard	10	F_2	
10 "	John Smith (Bates Packer)	51	0	
11 "	A. Beckwith	17	P_1	
12 "	T. Joslyn	16	F_1	Primary Complex, Lt.

9 Warehouse and Occupations Elsewhere in Plant

5+5 "	Wm. Farmsworth	5	F_1	Primary complex, Rt. + Lt.
5+25 "	E. Dinehart	13	0	
7 1/2+1 yrs.	Natzka	9	F_2	
8+3 yrs.	E. Earl	7	F_2	
9 +1 "	A. Hensel	93	F_2	

9 Warehouse and Occupations Elsewhere in Plant (Cont.)

Employed	Name	Case No.	X-Ray
9 1/2+21 yrs.	J. Reddins	12	F_2 Primary Complex Rt.+ Lt.
10 + 19 "	Mike Marrah	15.	P_1
12 + 10 "	Chas. Miller	6	F_1
15 + 7 "	Burt Smith	8	0? Primary Complex Rt.+ Lt.

13 Miscellaneous with Occasional Work in Warehouse

Chiefly Repair and Maintenance Crew

Employed	Name	Case No.	X-Ray
9 years	A. Monette (Mason, boilers and flues)	84.	F_3
11 "	F. Miller (Carpenter)	87.	F_2
12 "	D. Bowden	85.	0
12 "	E. Bogden ✓	83.	F_1
13 "	S. Fosdick	91.	P_1
13 "	Balfour	4.	0?
15 "	M. Freiday	89.	F_1 Primary Complex Rt.
16 "	E. Pender	92.	F_1
16 "	S. Christophero	49.	F_2
17 "	Nanni	90.	P_1 (Isolated TB.
20 "	H. Holm	88.	P_1 (both roots.
21 "	M. J. Hordan	97.	F_2
25 "	G. Lehman	95.	F_2 Primary Complex, Rt.

19 Miscellaneous - No Warehouse Exposure

Employed	Name	Case No.	X-Ray
9 "	D. Tillet	94.	F_2
9 "	F. Neth	98.	F_1
10 "	A. Burr	20.	F_1
10 "	L. Park	21.	F_1

19 Miscellaneous - No Warehouse Exposure (Cont.)

Employed	Name	Case No.	X-Ray	
11 years	E. Newton	44	F_2	
11 "	Kent	1	F_1	
11 "	Ed. Hale	99	F_2	Primary Complex, Rt.
13 "	C. Manetta	50	F_2	
13 "	B. Ianni (Mine 7 yrs.)	81	F_2	
14 "	H. McGuire	28	0	
14 "	E. Ernst (Brusher 8 yrs.)	55	F_1	
14 "	R. Laurrey (Mine 9 yrs.)	60	F_2	Old Tuberculosis
14 "	A. Schulk	82	F_1	
15 "	D. Caton (Mine 12 yrs.)	72	F_2	
15 "	K. Stevens	86	P_1	
19 "	L. Joslyn	39	F_2	
21 "	J. Ianni (Mine 12 yrs.)	65	F_1	
26 "	R. Schultz (Mine 11 yrs.)	58	F_2	
30 "	A. Speed	18	F_1	Primary Complex, Rt. and Lt.

From this analysis of the x-ray and clinical examinations, it would appear that gypsum dust inhaled in high concentrations over periods as long as 20 to 25 years does not produce changes in the lung which are incompatible with normal function. It cannot be maintained that this dust has no effect on the lungs for only 13 of the 101 men examined show what could be interpreted as negative lung roentgenograms, but there was no clinical evidence that gypsum inhalation had produced disability. When silica dust is also present in the industrial atmosphere with the gypsum dust this substance has not excited the reaction which experience in other industries would lead one to anticipate. At least 17 men appear to have had a sufficient exposure to silica to have brought about changes in their lungs demonstrable by x-ray but such changes could not be discovered. Two explanations have suggested themselves: either that the gypsum by virtue of its physical properties clumps the silica particles in the air into aggregates too large to be inhaled or that gypsum chemically modifies the tissue reaction to silica. In the absence of any data on the subject it seems more likely that the former explanation may be the proper one. As suggested, further study of the atmospheric dust is necessary, and it would also be desirable to procure autopsy material from men exposed as long as possible to mixtures of silica and gypsum, so that chemical analyses of their lungs might demonstrate how much silica actually penetrated their tissues. Opportunity for such a study is, of course, quite fortuitous.

The investigation has also demonstrated a complete lack of progressive tuberculosis among the gypsum workers who were examined. This finding substantiates the view that little silica has been inhaled, for any group exposed to silica for as much as 20 years should contain 10 to 15% with active tuberculous lesions. It has been claimed that gypsum dust protects against tuberculosis. H. Maendl (Zeitschrift für Tuberkulose 1921, XXXV, 184) quotes Fissak, without citing the source of his figures, to the effect that of 40,824 deaths among lime and gypsum workers only 17 or 0.41% were due to tuberculosis and that among 400 employees in one gypsum plant (presumably German or Austrian) no death from tuberculosis had occurred in 17 years. Examination of the death records in Oakfield and the nearby towns might demonstrate whether the incidence of deaths from tuberculosis or other respiratory disease was equal to or below that for other industrial communities. Two cases of active tuberculosis in gypsum workers from Oakfield have come to our attention so that we know it can occur.

PATHOLOGY - Lack of material forbids any elaborate discussion of the tissue changes produced by the inhalation of gypsum in pure form or in combination with silica or other substances. Animal experiments are in progress but the exposure period has not been sufficiently long to hazard an opinion as to the nature of the reaction. One autopsy on a gypsum worker was obtained through the efforts of Mr. Daniels at Oakfield. This man was not employed by the U. S. Gypsum Co. but by a competitor for a period of 6 years, presumably in various capacities but his occupational history was not obtained in detail. No x-ray films had been made of his chest prior to his death so that a comparison between roentgenogram and pathological lesions was not possible. Presumably the picture would have shown an accentuation of the linear markings, as there was a rather marked accumulation of dust along the lymphatic vessels accompanying bronchi, blood vessels and the connective tissues between the lung lobules. These structures were pigmented by the dust and slightly thickened by the formation of a small amount of new connective tissue but there was no fibrosis and no nodules such as occur in silicosis. There were nodules in the lungs and lymph nodes of "childhood tuberculosis" which had healed with very extensive calcification. Death occurred from coronary arterial disease which could not be associated with dust inhalation. The character of the pulmonary changes was that of the reaction produced by many non-irritating dusts, like soft coal and marble.

This report discloses that among the 101 long term employees of the U. S. Gypsum Company who have been examined, there is no case of definite silicosis nor one of active pulmonary tuberculosis. These findings were somewhat surprising in view of the fact that in some portions of the plant, notably near the mixer over the #12 Packer, there were total dust counts as high as 11 billion particles per cubic foot of air with a free silica content which might be as high as 3 billion particles. The facts that no silicosis occurred in the group of 6 men employed exclusively in this part of the plant, and that the one man who had worked on this particular machine for 10 years showed a normal chest, throws some doubt upon the existence of a hazard under the conditions encountered in this gypsum plant.

As an explanation the hypothesis was suggested that the tendency of gypsum to form aggregates clumped the silica particles into masses too large to be inhaled in significant quantities. Nevertheless it must not be taken for granted that with further exposure of 10 or more years these men would remain free from disease. The occurrence of an "F" classification in so many of the roentgenograms suggests that with continued exposure some of these men might ultimately develop serious pulmonary damage.

As far as gypsum dust is concerned nothing has been observed which would disturb our original feeling that this dust would prove to be quite harmless. Probably it is responsible for certain changes in the x-ray pictures of the lungs but there is nothing to indicate that these changes are associated with physical disability. Traces of active pulmonary tuberculosis are wanting and the experience quoted from Germany suggests that it is rare among gypsum workers. The evidence suggests that where a tuberculous infection is present the dust inhaled in this plant does not tend to cause it to become active for 18% of the pictures showed well healed foci of childhood tuberculous infections and 5% of them disclosed healed adult tuberculosis. However, it cannot be claimed that such infection never becomes progressive in men with gypsum exposures.

For these reasons it is of utmost importance to select for test cases individuals without active tuberculosis or obvious silicosis in order that unfavorable precedents may not be established in the gypsum industry. If it can be discovered that perchance such conditions exist among the group of cases scheduled for trial, we would urge that they be settled by compromise and that the test be based upon the typical case.

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