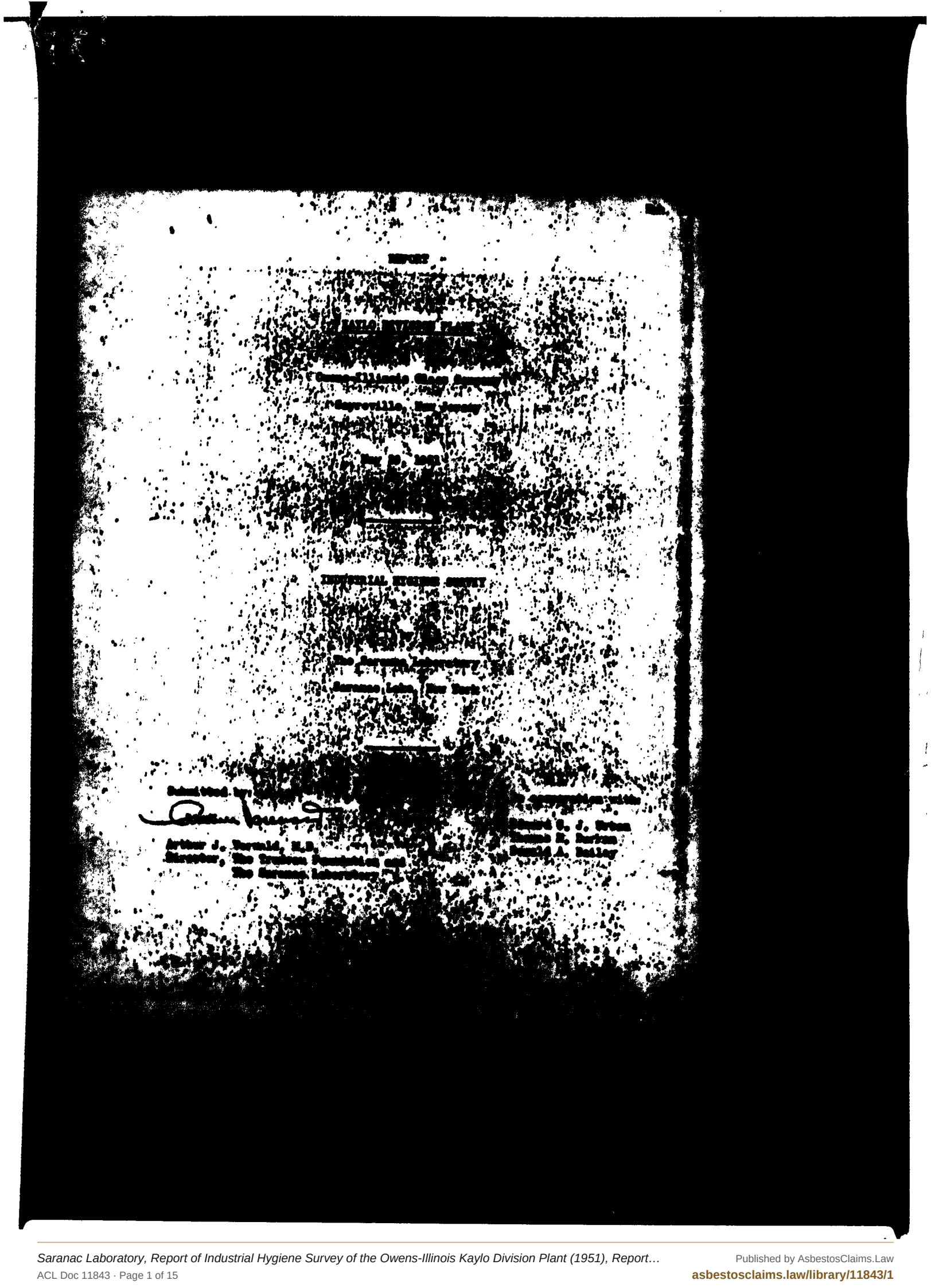


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Report of Industrial Hygiene Survey
of
Kaylo Division Plant, Owens-Illinois Glass Company
Sayreville, New Jersey

A survey of the Kaylo Division plant of the Owens-Illinois Glass Company, located at Sayreville, New Jersey, was made on January 29, 1951 by [redacted] of the Saranac Laboratory in company with W. S. Hazen of the Owens-Illinois Company. The purpose of the survey was to observe the plant operations and to discover whether any hazards to health might be expected by dust liberated from the raw materials handled or from the finished products manufactured. Dust counts of atmospheric samples taken [redacted] operations with the Greenburg-Smith impinger apparatus were made to determine the concentration of air-suspended dust to which the workers were exposed. Seven samples of atmospheric dust sufficient for analysis were collected on paper filters with a vacuum cleaner device so that the crystalline free silica and asbestos content, in the air-borne material could be estimated. The filters were of a specially prepared [redacted] which readily retained dust particles [redacted] The sampling [redacted] was begun on January [redacted] and was completed the same day. [redacted] were made, but the others did not [redacted] Owens-Illinois Company. The raw [redacted] and their composition was determined [redacted]

[redacted]

The [redacted] raw materials were [redacted] fire-insulated fabrics, [redacted] small amounts of binding

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and cement are required but these two items are not related to any dust hazard.

Of the six raw materials described in table 1, all except quick lime must be regarded as potentially hazardous and capable of causing a serious pneumoconiosis. Inhalation of crystalline or chrysotile can produce asbestosis and inhalation of silica flour or tripoli can cause silicosis. Diatomaceous earth on inhalation is capable of producing a diffuse fibrosis which is unlike silicosis or asbestosis but which may be quite disabling.

The finding that the sample of aggregate had a quartz content of 21 per cent is quite surprising. It is doubtful that exposure to this commercial form of aggregate may present a potential hazard not only from asbestos fibers but also from free-silica particles.

The finished product, Kaylo, appears to consist principally of a crystalline form of calcium silicate which yields a characteristic x-ray diffraction pattern. Petrographic and chemical examination revealed, however, that other constituents are present in the material. A sample of light grade Kaylo was shown by analysis to have a quartz content of about 3 per cent; for the heavy grade the value was about 5 per cent. Both grades also contained moderate amounts of asbestos. In a sample of the light grade the asbestos was in the form of chrysotile which comprised approximately 5 to 10 per cent of the sample. For a sample of the heavy grade the chrysotile content was estimated to be about 5 to 10 per cent but, in addition, about 3 to 5 per cent of amosite asbestos was seen. Carbonates make up about 1 per cent of each grade of Kaylo.

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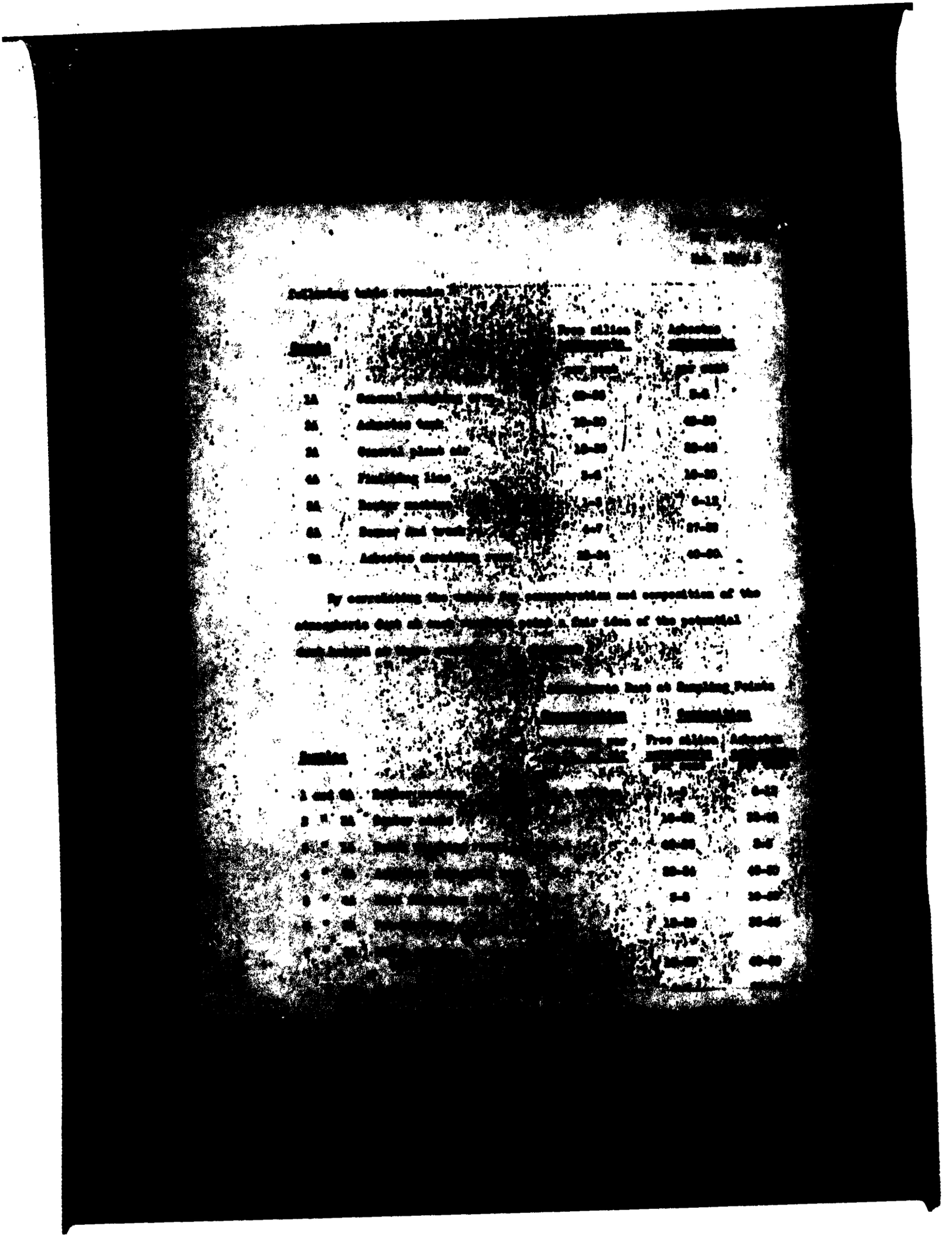
Concentration and Composition of Atmospheric Dust

The concentration of the atmospheric dust to which the workmen were exposed at various points is shown by the dust counts in table 2. Information pertinent to the operational conditions at each sampling point are included in the table. A summary of the dust counts is as follows:

Sample		Particles per cu.ft. of air	
		Smaller than 10u	Larger than 10u
1	Router machine	4.4 million	0.08 million
2	Center aisle	2.4 "	0.16 "
3	Batch weighing room	2.1 "	0.26 "
4	Asbestos unbagging room	6.0 "	0.14 "
5	East finishing line	3.3 "	0.48 "
6	Pre-hardener	2.2 "	0.45 "
7	Mixer balcony	2.2 "	0.09 "

The composition of the material suspended in the air at seven representative locations is revealed by the analyses in table 3; from the data in table 4 the weight of dust in the atmosphere at these seven locations can be calculated. Thus, the dust load of the general plant air (sample #2) was 0.2 gram in about 17,000 cu. ft. of air or 0.01 mg. per cu. ft., while the dust load of the atmosphere at the other locations ranged from 0.08 to 0.4 mg. per cu. ft. The [illegible] fraction of the dust consisted of the free silica components (quartz and diatomaceous earth) and the asbestos components (crysotile and amosite). These hazardous constituents generally made up a large portion of each dust sample, as the

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Summary

The results of the dust survey, which included the analysis of raw materials and atmospheric dust and a limited number of dust counts, make it apparent that considerable attention has been given in this plant to the control of dust. Exhaust systems of removing the dust had been installed and the amounts of dust suspended in the plant atmosphere was revealed by the survey to be at relatively low levels. Since, however, in many areas of the plant hazardous free silica and asbestos minerals comprised a large portion of the air-floated material, it is very important that effective dust control measures be maintained at all times so that the dangerous or unsafe amounts of dust into the atmosphere will be prevented.

A number of agencies have suggested threshold or maximum allowable limits for the concentration of dusts in industrial atmosphere. In 1948 the Department of Health for the State of New Jersey informed the Saranac Laboratory that the Department followed a "Sanitary Code" which recommends certain threshold limits for dust exposure. A somewhat similar code has recently been developed by the American Conference of Governmental Industrial Hygienists. Threshold values established by these codes are as follows:

(The threshold values are given on the next page)

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[illegible] that sampling point, the weight of dust collected there with the known airflow during and filter given indicates that the dust concentration inside the hopper was possibly of the order of 50 million or more. Since about one-third of the dust was respirable, it seems likely that a potentially hazardous condition existed.

Suggestions and Recommendations

1. It is suggested that minimum exhaust ventilation rates which will provide effective dust collection for each branch of the dust control system be determined, unless this has already been done, and that the suction of these branches be checked periodically. Static pressure measurements can be used to measure air flows.

2. The exhaust system for the asbestos scrapping room should be redesigned so that the suction hoods will be located close to the points where the dust is produced to collect it before it contaminates the general air. It might be feasible to feed the asbestos bags into a small hopper and chute rather than on to an open platform. The hopper could have a rotary feeding device for feeding the asbestos on to the riffle tables. The [illegible] provided [illegible] by flexible hoods and should be enclosed. Ventilation of the room should be improved by periodically [illegible] the ceiling beams.

3. Housekeeping practices should be improved in a number of areas of the plant. All the routine sweeping and dust should be removed from the machines [illegible] using a sufficient number of containers provided for the purpose located [illegible]. In the mixer building each should be taken on [illegible] and the area

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	Maximum Allowable Concentration (Particles per cu.ft. of air)	
	New Jersey code	Am. Conf. Gov. Ind. Hyg. code
Asbestos	5 million	5 million
Free silica:		
more than 70%	5	—
" " 50%	—	5
40% to 70%	10	—
5% to 50%	—	20
5% to 40%	20	—
less than 5%	50	20
Total dust	50	50

A review of the survey data discloses that in certain areas (such as the batch weighing room) free silica comprised a large portion of the dust to which the workers were exposed; in other areas (asbestos tank and bonder) asbestos was the principal component of the air-suspended material; and in still other locations (roving, slide and asbestos wrapping room) substantial amounts of both free silica and asbestos were present in the atmospheric dust. It is thus apparent that although the dust counts of the seven impinger samples were all below 10 million, and therefore relatively low, the rather high quartz or asbestos content of the air-suspended material tended to create an unhygienic condition which might be hazardous, or millions and might exceed the maximum allowable limit established by code. Specific examples which lie the exposure to free silica in the batch weighing room, and to asbestos in the slitting wrapping room, also, the concentration of samples from which the investigator probably considered code limits. Although [illegible] was made during the survey

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should be cleaned periodically.

4. Special attention should be given to housekeeping in those areas where silica flour, tripoli, diatomaceous earth and asbestos are handled. It was noted during the survey that bags of these materials were stored in large piles throughout the plant area where space was available. Some of the bags were broken and covered with dust. Dust arising from this source would tend to contaminate the atmosphere of the entire plant.

5. It is recommended that a suction hood be installed in front of the operator who manually turns over the Kaylo tiles on the conveyer belt.

6. All employees working at points where dust is created should be educated in good dust suppression practices. As an added safeguard, it is suggested that those who work at dusty jobs be required to change their work clothing frequently.

7. Since it appears that men loading box cars are probably exposed to a hazardous concentration of air-suspended asbestos fibers, it is recommended that the men wear U.S. Bureau of Mines approved respirators during that operation. It would be preferable, of course, to reduce the dust concentration by exhaust ventilation or some other practicable method if at all possible.

8. Dust count surveys should be made in the plant at regular monthly intervals until a low level of dustiness in each potentially-hazardous area is established. The surveys can then be done less frequently.

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5. The maintenance of the working environment in a condition which conforms to regulations promulgated by local health agencies or which is in accord with accepted standards of good practice should not be considered as a complete protection for a worker from acquiring a disease as the result of his occupation. It is strongly recommended that at the Kaylo plant a medical program be maintained which would require a pre-employment examination, including a roentgenogram of the chest, of all prospective employees and a routine chest roentgenogram of all regular workers at intervals of, once each year. Such a program should reveal those individuals who are unfit for employment in a dusty trade. Of most importance, any case of disease which might develop in the regularly employed workers would be found early, before it became a serious health problem to the individual and a liability to the management.

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ANALYSIS OF RAW MATERIALS USED IN THE MANUFACTURE OF BOARD

Material	Composition	Size of Particles
Amosite	The bulk of the material was fiberous. Many of the fibers were separated; these did not possess the high degree of flexibility of chrysotile. Grains of chromite or serpentine were adhering to some of the fibers. The sample of the amosite brought back from the Kaylo plant had a quartz content of 21 per cent.	Most of the fibers were several hundred microns to several cm. in length; relatively few were shorter than 20 microns. Many of these fibers were 1 micron or less in diameter and, unlike chrysotile, were generally straight or only slightly curved. About 5 per cent of this material (by weight) would pass a 100 mesh screen; in this smaller-than-100 mesh fraction about one-fourth of the fibers were longer than 20 microns and for every fiber there were about 8 particles.
Chrysotile	More than 90 per cent fiberous chrysotile. Adhering to most of the fibers were grains of chromite (?), carbonate, a few grains of massive serpentine and a trace of chrome. About 0.5% quartz also was present.	The fibers were well separated. Many were several hundred microns long and some were several cm. in length. About 10 per cent of the material (by weight) would pass through a 100 mesh screen; in the smaller-than-100 mesh fraction about one-fourth of the individual fibers were longer than 20 microns and for every fiber there were about 12 particles. In this fraction suspended bundles were about as numerous as separated fibers.
Diatomaceous earth	Principally natural diatomaceous earth with a trace of quartz. Probably some clays were present. Sodium and the iron were present (?).	Probably more than 90 to 95 per cent of the particles were smaller than 1 micron.
Quick lime	Nearly all lime, with 0.5% quartz and traces of serpentine, feldspar and glass.	Mostly smaller than 2 microns and rarely larger than 10 microns. Occasional clumps larger than 20 microns were seen.
Silica flour	Almost entirely pure finely-ground quartz.	Probably more than 90 per cent of the particles were smaller than 5 microns.
Graphite	Almost entirely graphite, [illegible] quartz.	Probably more than 95 per cent of the particles were smaller than 5 microns; only rarely were any larger than 10 microns seen.

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CONCENTRATION OF ATMOSPHERIC DUST AT VARIOUS SAMPLING POINTS IN PLANT

All samples were taken with the midget impinger. The collecting fluid was 50% ethyl alcohol.

Sample #1: Router machine. Taken at 2:45 P.M.; 10 min. sampling time.
Router machine cutting Kaylo blocks into pipe insulation forms. Sample represented exposure of two men at router machine outlet removing pipe insulation forms and applying cloth coatings. A light glue was sprayed on the forms with compressed air spray guns to make the cloth adhere to the Kaylo. The cutting parts of the machine were enclosed by sheet metal housings which were exhausted by a central suction system. The exhaust points were checked by smoke tests and were found to have strong suction. This same central exhaust system also served the wool finishing line, which was not in operation at the time. Since the exhaust points of the wool line were closed off by dampers, the volume of exhaust at the router machine was substantially increased.
The router unit was located in the open plant area. Moderately heavy accumulations of Kaylo dust covered the undercarriage of the machine. The operators discarded broken pieces of insulation by throwing them into open containers. Several containers were filled in a short time and the excess discards fell to the floor. Housekeeping in the machine area was only fair.
Dust concentration: particles per cu. ft. of air
6.4 million smaller than 10μ. (Nearly all of these particles appeared to be 3μ or less in length.)
0.08 million larger than 10μ. (10 to 20μ in length.)

Sample #2: Center aisle. Taken at 3:10 P.M.; 10 min. sampling time.
General air sample along center aisle between direct-fired driers and indoor router units. The units were of a completely enclosed construction. Only a slight volume of steam was noted escaping into the general air. Housekeeping was good.
Dust concentration: particles per cu. ft. of air
5.4 million smaller than 10μ. (Most of the particles were 3μ or less in length.)
0.16 million larger than 10μ. (10 to 20μ in length.)

Sample #3: Kaylo weighing room. Taken at 3:30 P.M.; 8 min. sampling time.
General air sample in Kaylo weighing room area. No weighing was being done at time of sampling was close to the changing of shifts. Other normal activity was going on. Housekeeping in the area was in fair to good order and the general ventilation conditions were good. The dumping points of the dust storage bins into the weighing containers were each provided with exhaust systems. These exhaust points were checked by smoke tests and the suction was found to be only fair. During an inspection made earlier in the day visible amounts of dust were seen to escape into the general room air from the dumping points during weighing.
Dust concentration: particles per cu. ft. of air
[illegible] million smaller than 10μ. (Most of the particles were 3μ or less in length.)
[illegible] million larger than 10μ. (Some 10μ in length.)

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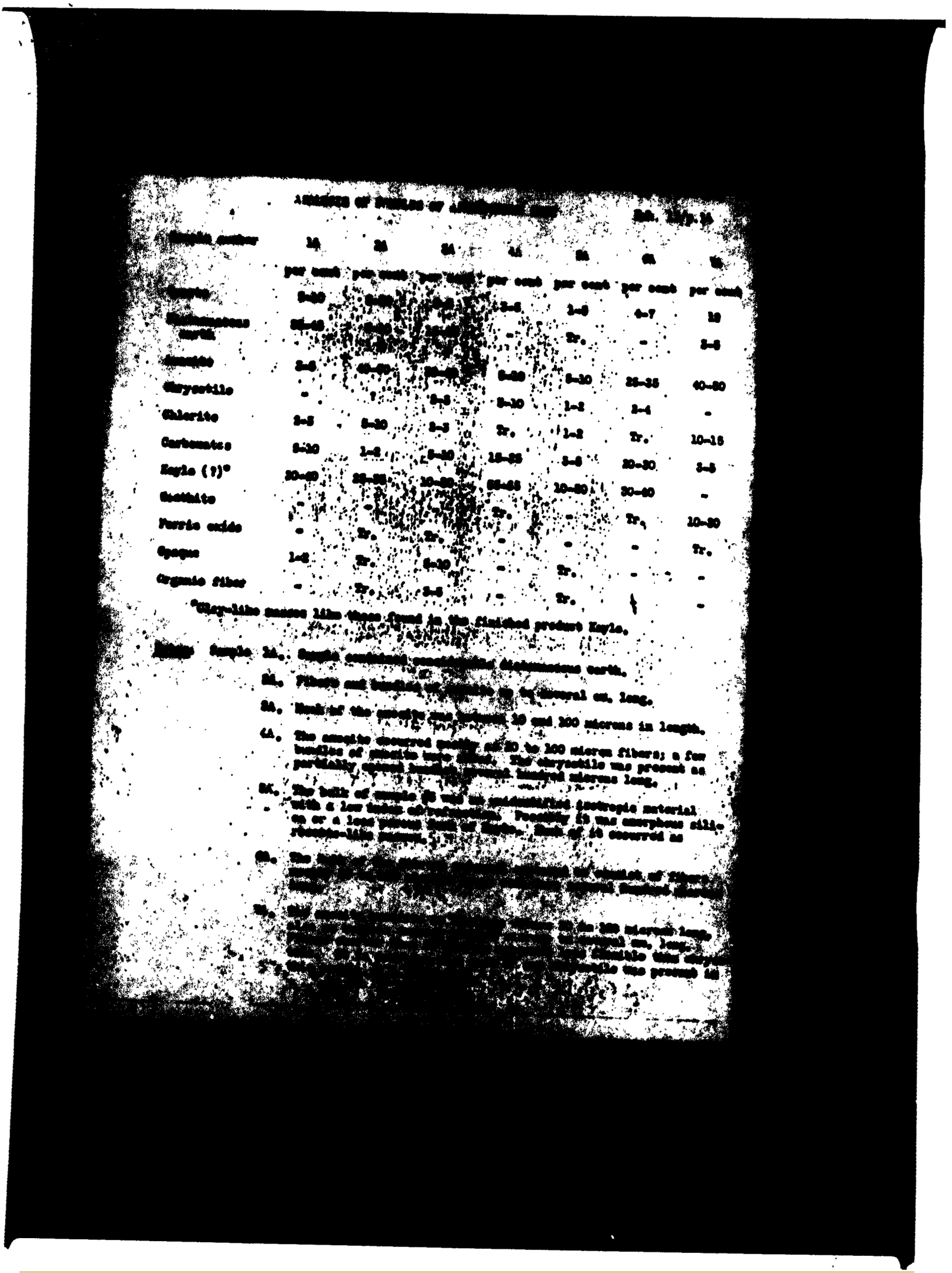
Dust concentration: particles per cu. ft. of air
6.9 million smaller than 10μ. (Most of the parti
cles were 5μ or less in length.)
0.16 million larger than 10μ. (Near 20μ in length

Sample #5: Dust finishing line. Taken at 4:18 P.M.; 5 min. sampling time.
Exposure of [illegible] tiles leaving Kaylo structural tiles by hand on a
conveyor belt located in the center of the finishing line. All adjacent
finishing operations were enclosed and were provided with exhausts. Under
pressure of dust were rising when the men turned the tiles. The finishing
line was located in the open plant area. Housekeeping was good.
Dust concentration: particles per cu. ft. of air
8.8 million smaller than 10μ. (Most of the parti-
cles were 5μ or less in length.)
0.48 million larger than 10μ. (Mostly 10 to 15μ
[illegible] one was 100μ long.)

Sample #6: [illegible] 10 min. sampling time.
[illegible] General air sample of the
area in which there were [illegible] The slurry of Kaylo was pumped
into molds and then placed [illegible] into the prehardener. A
moderate amount of dust was in the atmosphere around the machine.
Dust concentration: particles per cu. ft. of air
1.8 million smaller than 10μ. (Most of the parti-
cles were less than 5μ in length.)
0.48 million larger than 10μ. (Up to 15μ in leng

Sample #7: [illegible] 10 min. sampling time.
[illegible] were dusty when [illegible] (Most of the
particles were less than 5μ in length.)

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Sample number	1A	2A	3A	4A	5A	6A	7A
	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Quartz	5-10	5-10	5-10	2-5	1-2	4-7	10
Montmorillonite	85-95	80-90	75-85	-	Tr.	-	5-8
Kaolin	2-5	45-50	25-30	5-10	5-10	25-35	40-50
Chrysotile	-	-	5-8	5-10	1-2	2-4	-
Chlorite	2-5	5-10	2-5	Tr.	1-2	Tr.	10-15
Carbonates	5-10	1-2	5-10	15-25	5-8	20-30	2-5
Kaylo (?)*	20-30	25-35	10-20	55-65	10-20	30-40	-
Gothite	-	-	-	Tr.	-	Tr.	10-20
Ferric oxide	-	Tr.	Tr.	-	-	-	Tr.
Opaque	1-2	Tr.	5-10	-	Tr.	-	-
Organic fiber	-	Tr.	2-5	-	Tr.	-	-

*Clay-like masses like those found in the finished product Kaylo.

Sample 1A. Sample contained considerable diatomaceous earth.

2A. Fibers and bundles of fibers up to several cm. long.

3A. Most of the crocidolite fibers between 10 and 200 microns in length.

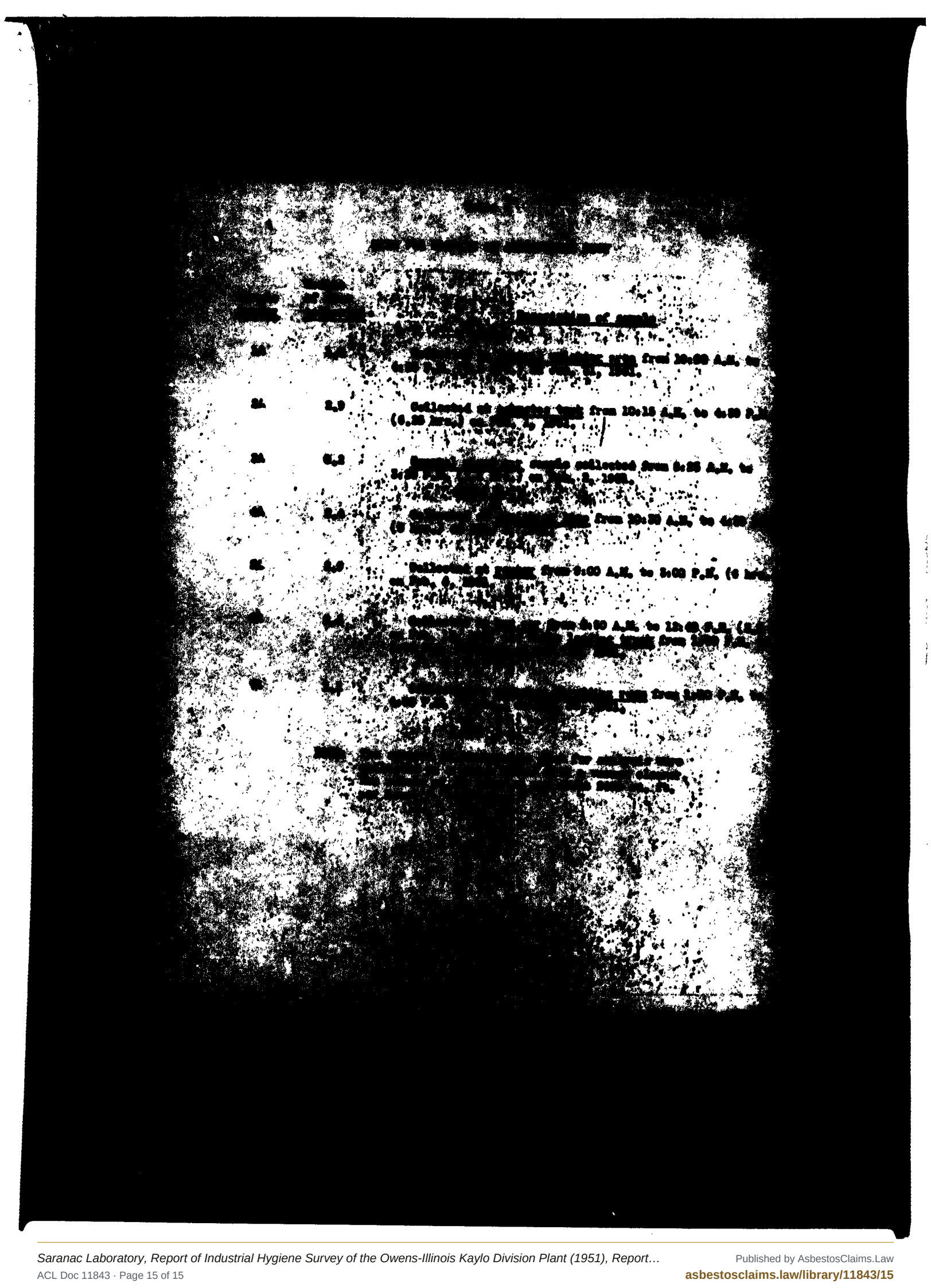
4A. The asbestos observed ranged from 10 to 200 microns fibers; a few bundles of fibers were found. The chrysotile was present as partially opened bundles of fibers longest microns long.

5A. The bulk of sample 5A was an unidentified isotropic material with a low index of refraction. Possibly it was amorphous silica or a low index glass of kaylo. Much of it occurred as

6A. The [illegible] of fibers

7A. [illegible] 200 microns long.
[illegible] cm. long.
[illegible] was present as

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