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Minutes: Air Hygiene and Manufacturing Committee
June 3, 1965
Motel LeProvence
Thetford Mines, P. Q. Canada
10:30 A.M. to 3:00 P.M.

Attending:
Members:

L. C. Williams, Chairman	Raybestos-Manhattan, Inc.
W. C. Atkinson	Johnsville-Manville Corp.
D. T. Austin, Jr.	United States Rubber
C. L. Sheckler	Johns-Manville Corp.
R. B. Smith	Raybestos-Manhattan, Inc.
A. C. Link	United States Rubber
T. C. McCluskey, Jr.	Tallman-McCluskey Fabrics Co.
K. W. Nelson	American Smelting & Refining Co.

Guests:

Dr. K. Smith	Johns-Manville Corp.
Dr. L. J. Cralley	U.S. Public Health Service
Dr. J. H. Wolfsie	Medical Director-U.S. Rubber
Dr. P. Cartier	Thetford Mines Clinic
Maurice Lachance	Q.A.M.A.
Jerry Mitchell	British Belting & Asbestos Ltd.

Absent:

H. Walter	American Asbestos Textile
A. P. Gouveia	H. K. Porter Co., Inc.

Public Health Service Survey
Dr. Lewis J. Cralley
Scientist Director, Assistant Chief

Dr. Cralley presented a paper (draft copy) prepared by Jeremiah B. Lynch of the Department of Health, Education and Welfare titled "Asbestos Study - Procedures and Findings". Particular attention was given to Table 1. This table shows the improvement industry control programs have had on dust concentrations.

Table 1
Dust Concentrations - Asbestos Textile Surveys

SURVEY	Penna.	PHS 1938		Public Health Service
	1934	Without	With	1964
		Control	Control	
Concentration in mppcf				
Range of concentration)	67.0	36.0	2.6	2.6
	to	to	t	to
	3.8	7.1	1.2	1.2

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Two (2) charts were also presented. The first showing Average Dust Concentration by Plant and Operation in department Fibre Preparation, Carding, Spinning, Twisting and Weaving. The second chart was on Dust Concentration by Operation. The chart bars were identified as IMPINGER x10, MF Total Fibers, MF Fibers > 5µ, MF Fiber > 10µ and show the Fibres/cc when using the IMPINGER x10 vs the membrane filters counted at 430 X Phase Contrast.

All indications point to good dust control in the Textile Plants. Dr. Cralley cautioned us not to become complacent as it is important to keep improving systems at every opportunity and further, we do not know at this time what the data means with respect to health.

Dr. Cralley distributed another paper titled "Relationship of Impinger Counts to Fibre Concentration by Membrane Filters in Asbestos Textile Plants" prepared by H. E. Ayer, G. H. Edwards, J. H. Fanney, Jr., J. R. Lynch, U. S. Department of Health, Education and Welfare. The committee will review this paper and will discuss same at the next meeting. When both these papers are finalized, they will be published. The Textile phase of environmental studies will be completed by fall of 1965 and all data published will be of interest to the membership.

Dr. Cralley is meeting with the groups doing field studies. Also, with Insurance - Air Hygiene Groups, Seminar at the Universities of Texas, Oklahoma and Pittsburgh, Scientific and Medical Groups and at the International meeting, 1966 in Vienna, Switzerland.

During the discussion period several points were made:

1. There is a 25% error in dust counting.
2. Where there is a 5000 total count the fibre count is considerably lower around 1000.
3. Plants should make all data pertinent to this program available.
4. Dr. Cralley's group has completed 10 plants surveys. There are 2 remaining.

Portable Vacuum Cleaners

Two (2) units, 1) Suction Apparatus and 2) Compressed Air Unit were tried. Both units do a satisfactory cleaning of easy to reach areas but in equipment and close areas, they are not adequate.

The committee has agreed that for the present this investigation is complete and we do not know of any available vacuum unit that will replace air hose cleaning method used by most of us. We would request any member to report any new units as they become available so we can investigate their possible use. We are all very interested in retiring the air hose method at the earliest possible date.

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Direct Dust Counter

Information received by Ken Nelson states Bausch and Lomb are developing a new Direct Dust Counter light and a photo electric cell to count all dust particles in the air. When this unit is developed it may eliminate much of the manual counting presently being done.

Three main factors make a unit such as this desirable:

1. Eliminate the human factor.
2. Take more readings in a shorter period of time.
3. Cost of unit estimated at \$3300.00.

Ken Nelson will follow up with Bausch and Lomb, and if a unit is ready by the October meeting, a request will be made to have it demonstrated at that time.

Consultant Industrial Hygiene Program

A suggestion has been received to discuss and investigate the possibility of Asbestos Textile Manufacturers retaining a consultant to supervise a uniform industrial hygiene program and to conduct periodic surveys of plants.

Generally, the consultant would check dust concentrations and noise levels in plants. He would then be available to give his findings as an outside report. This would be an aid to the industry whenever they are confronted with compensation cases, as he would have facts and history on actual in-plant conditions.

The committee is aware that more cases are going to be filed as time goes on and with this fact it was agreed all members will consider this suggestion and report their wishes at the next meeting. When reviewing, keep in mind

1. Hearing cases - 4 in New Jersey
1 in Quebec
1 case cost \$38,000 at age of 69-1/2 years.
2. Cost of Consultant approximately \$150 to \$200 per day plus expenses.

Automatic Loom Cleaning

Parks-Cramer have developed a new unit called Weave Cleaner-Travel Vac which has much higher velocity air - cooperating vacuum. They claim the unit is more effective than the compressed air hose and the broom without their disadvantages. Any member interested in further information should contact Parks-Cramer Company, Fitchburg, Mass./Charlotte, N. C./Atlanta, Ga.

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Published Pamphlet - "Method for Determining Asbestos Dust Concentration"

Since our meeting in Pinehurst last February we have disposed of 27 copies of subject pamphlet. These went to:

American Asbestos Textile Corp.	5 copies
Asbestos Magazine	9
Asten-Hill Mfg. Co.	4
Zonolite (Div. of I.R. Grace Co., Libby, Montana)	1
Alta Friction S.A., Mexico	1
North American Asbestos Corp., Chicago	5
Central Asbestos Co., Ltd., London, Eng.	1
Mines Dept., Ministry of Commerce & Industry Nicosia, Cyprus	<u>1</u>
Total	27

Balance on hand, approximately 859 copies.

Each member is requested to help to distribute the pamphlet whenever there is any interest. The pamphlets that have been distributed meet the needs of the receivers as we have never received any suggestions for revision of any part.

In order to generate more interest by covering a larger part of industry an advertisement is being placed in the Journal of Industrial Hygiene.

General

The committee and guests wish to express their sincere thanks to the Miners for a very educational and pleasant meeting at Thetford Mines, P. Q., Canada.

Respectfully submitted,

L. C. Williams, Chairman
Air Hygiene & Mfg. Comm.

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ASBESTOS STUDY - PROCEDURES AND FINDINGS

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TR-25

SEPTEMBER 1965

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Occupational Health

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ASBESTOS STUDY - PROCEDURES AND FINDINGS

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Jeremiah R. Lynch

Occupational Health Research and Training Facility
1014 Broadway
Cincinnati, Ohio

TR-25

September 1965

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U. S. Department of Health, Education, and Welfare
Public Health Service
Division of Occupational Health

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ASBESTOS STUDY - PROCEDURES AND FINDINGS

INTRODUCTION

In the early 1900's massive exposures in the dusty trades were common and the situation in American asbestos processing plants was no exception. The ability of asbestos dust to cause pneumoconiosis had been recognized for some years and a series of studies sought to define the dose-response relationship. In 1934 the Department of Labor and Industry of the State of Pennsylvania undertook an investigation of asbestos fabricating plants but was unable to establish the maximum safe concentration of asbestos dust in the air.⁽¹⁾ In 1938 the U. S. Public Health Service related dust concentrations to incidence of disease and recommended that 5 million particles per cubic foot, as measured by the impinger method, be regarded tentatively as the threshold value for asbestos dust until better data were available.⁽²⁾ This "tentative" standard has been used for 28 years. These investigations were one-time studies of actively employed asbestos workers. However, due to the long period of time between exposure to asbestos dust and onset of disease, a prospective study which follows the workers for a period of years, during and after the exposure, is required to define adequately the safe level of exposure. In addition to this lack of sufficient information upon which to base a standard for the prevention of asbestosis, a number of investigators have reported an association between exposure to asbestos and the occurrence of certain malignancies. Consequently, the U. S. Public Health Service has undertaken an occupational health study of the asbestos products industry.

OBJECTIVES

The objectives of this present study are as follows:⁽³⁾

1. To determine the health status of the asbestos workers in this industry with special attention to diseases of the respiratory tract.

2. To determine which environmental factors have an adverse effect upon the health of asbestos workers in the asbestos-products industry.

3. To determine the relationship between occupational exposure and cause of death of asbestos workers.

4. To develop medical and environmental criteria and procedures for the control of health risks identified by the studies."

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ASBESTOS STUDY

METHODS

The over-all study is divided into three semi-independent phases: biometric, medical and environmental. The biometric phase of the study uses data obtained from the Bureau of Old Age and Survivors Insurance (BOASI) to calculate the mortality among asbestos workers. These mortality rates are compared to those of similar unexposed occupational groups to indicate those diseases for which there appears to be an excess risk related to occupation. Later, as BOASI reports the filing of death claims on members of the groups of workers identified in the environmental phase, death certificates and autopsy data, when available, will be collected to determine the causes of deaths among these groups.

The medical phase of the study will consist of base line and routine follow-up examinations on a part of each group of workers included in the environmental phase. Appropriate tests and examination procedures are being devised.

In the environmental phase of the study the hazards to which the workers are exposed are measured by surveys of asbestos processing plants. Between January 1964 and April 1965, eight textile plants, three friction product plants, and one plant producing hydraulic packing were surveyed. Additional measurements will be made in these plants at intervals of a year or more as part of this prospective study. Detailed interviews are also being conducted to obtain identifying information, occupational histories and smoking histories on each worker included in the groups or "cohorts" of workers on whom exposure measurements have been collected.

A field team consisting of three industrial hygiene engineers and a dust counting technician, augmented by State industrial hygiene personnel when available, performs the environmental survey of each plant. After meeting with management and union representatives to explain details of the operation, the team collects samples throughout the plant following the production route. All of the impinger samples taken are counted within 36 hours at a field laboratory set up convenient to the plant. All their samples are returned to the Division of Occupational Health laboratories in Cincinnati for later counting or analysis. In addition to sampling, local and general exhaust ventilation systems are studied and certain other information, such as machine speed, is obtained.

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ASBESTOS STUDY

The types of samples collected can be divided into four categories.

I. Bulk samples. Several pounds each of the different types of crude fiber, bag house waste and treating and lubricating oils used are collected at each plant. These samples are subjected to such analyses as x-ray diffraction for minerals including free silica, mass spectroscopy for such metals as nickel and chromium and other analyses for polycyclic aromatic hydrocarbons and natural radioactivity.

II. Long period gravimetric samples. Several instruments for obtaining mass samples of total and respirable dust are run simultaneously in a representative area in the midst of each operation. These instruments include a high volume sampler, a Hexhlet modified to take a membrane filter, a conicycle, an electrostatic precipitator and a set of four membrane filter field monitors with and without 10 mm cyclone pre-samplers. An additional high volume sampler is set up outside the plant to sample the makeup air being used. Certain of these samples are analyzed for the same constituents as the bulk samples. Other methods of analyses are being developed to estimate the respirable mass of asbestos.

III. Simultaneous impinger-filter samples. Breathing zone samples taken with an impinger and a membrane filter simultaneously are used to obtain a comparison of these methods of dust enumeration. Other sets of impinger-filter simultaneous samples, with and without horizontal elutriator pre-samplers, are taken in the general room air near specific operations.

IV. Personal samples. Membrane filter field monitors connected to personal sampler pumps are worn by workers with the monitor attached to their collars. These samples are collected for one to two hours at a rate of 1.5 or 2.0 lpm. In the large plants personal samplers are worn by about half the workers while in the small plants almost all the workers wear them.

Impinger samples are counted in a Dunn cell using a 16 mm (10X) light field objective, 10X ocular with a Porton eyepiece reticle and Kohler illumination. Membrane filters are rendered transparent with a mixture of dimethyl phthalate and diethyl oxylate and counted with a 4 mm phase contrast objective and 10X ocular.

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ASBESTOS STUDY

RESULTS

All of the data presented here represent optical dust counts on impinger and filter samples taken in asbestos textile plants. The average results for impingers (Figures 1 and 2) are presented by plant and operation so as to permit comparison of the effectiveness of dust controls.

Asbestos enters the textile mill in 100 lb. pneumatically packed bags of opened fiber. The first operation, fiber preparation, includes the "picking" of the fiber to loosen and further open the material, followed by blending. Usually cotton, rayon or other fibers are mixed with the new fiber and in some cases, bag house waste and rendered yarn are added. Each ingredient is weighed, mixed and sent by pneumatic conveyor to a "condenser" which separates the asbestos from the air. The dust concentrations for fiber preparation reflect the degree of enclosure used at the different plants. Plants 2 and 4 used almost totally enclosed systems such that the asbestos did not emerge until it dropped out of the condenser. In the other plants manual handling was involved in moving the fiber from one step to the next and dumping into hoppers.

The carts of blended fiber are moved into carding and the fiber is manually transferred to the card hoppers. The card combs the fibers into a web which is separated into strands to form a "roving" wound on spools at the end of the machine. All cards were enclosed since it would be impossible to operate a card without almost complete enclosure and stay under the TLV. The dust concentrations in carding were inversely related to the volume of air exhausted and the tightness of enclosure. All air volumes were above the 800 cfm per card recommended by the Committee on Industrial Ventilation of the American Conference of Governmental Industrial Hygienists⁽⁴⁾ and some were over twice that figure. However, none were as high as the 2300 cfm per card used in one English asbestos textile mill.⁽⁵⁾

The spinning machine imparts a twist to the parallel fibers in the strand of roving to produce a yarn. Plant 3 had no exhaust on the spin frames and the exhaust in Plant 1 was ineffective due to a plugged duct. Plants 4 and 5 both had good down-draft local exhaust systems with baffles in front of the spools to limit the open area to the top where the roving entered. Plant 2 had no local exhaust but a very large general exhaust system removing 120,000 cfm from a room of approximately 450,000 cubic feet containing 60 spinning and twisting frames.

The yarn produced by the spinning frame is next plied with some other yarn and possibly nylon, glass or metal threads on a twisting machine.

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ASBESTOS STUDY

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concentrations were partly related to higher machine speeds, which ranged over 3000 RPM as opposed to less than 2000 RPM in spinning. Another contributing factor was the practice of unwinding a spool on the high speed shaft to locate a broken wire. This resulted in beating the twisted yarn against the frame and occasionally produced dust levels in excess of the TLV. The average concentration in twisting in Plant 3 exceeded the TLV and probably resulted from the use of dusty raw fiber, which created generally higher dust concentrations in this plant. Plant 4 used a "speeder" or "slubber" twister instead of a ring twister. This machine enclosed the yarn on its way to the spool and thus produced less dust.

The twisted asbestos yarn, synthetic fibers and wire are then woven into cloth or tape. Tape weaving was less dusty than cloth weaving. Plant 1, for example, wove only tape and had low concentrations at the weaving operation in spite of generally higher concentrations at other operations. Most plants wet either the warp or the filling or both to reduce the dust. This was very effective in Plant 4 where a water spray thoroughly doused the warp. Plant 3 also used wet control by submerging the filling in a bucket of water before loading into the shuttle. Apparently not enough water penetrated the tightly wound cop and considerable dust emanated from the unventilated machine. Plant 2 wove cloth entirely dry, due to customer requirements, but had a well designed canopy hood with side and partial front baffles which was successful in removing the dust. Apparently, either wet weaving or good local exhaust is effective in maintaining dust concentrations below the TLV.

These results showed that average dust concentrations in asbestos mills were generally below the threshold limit value and in some cases very much below this limit. Tremendous progress has been made over the past 30 years as can be seen from Table I. The 1934 Pennsylvania survey occurred at a time when controls were relatively unknown and dust exposures were massive. By 1938, when the Public Health Service studied plants in North Carolina, some controls were in use and concentrations were measured with and without controls. No control system had yet been devised for spinning and only one twisting machine had local exhaust. Average dust levels reported here are well below the previous levels but about 10 per cent of the individual measurements are still over 5 mppcf. Effective engineering dust control practices are available and application of these methods would eliminate the occasional high dust concentrations.

Dust concentrations on membrane filters counted with a 4 mm phase contrast objective cannot be evaluated by the same TLV established for impinger samples counted with a 16 mm light field objective. Comparison

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If fiber concentrations on filters with total particles by impinger do not yield a high correlation since the two methods are not measuring the same thing. However, an approximate equivalence has been derived by the methods described by Ayer, et al.⁽⁶⁾ The number of fibers per cc equivalent to one million particles per cubic foot arrived at by these methods is: 10 total fibers or 6 fibers longer than 5μ or 3 fibers longer than 10μ .

The results of over 600 membrane filter samples are summarized in Figure 3. Each of the bars represents the average concentration of the samples taken in each operation in four plants. In order to compare impinger results, the average dust concentrations measured by impinger (see "1964" column, Table I) have been converted to equivalent total fiber concentrations using the above approximate relationship. These are shown as circles on Figure 3. If the ratio of total fiber concentration by membrane filter to dust concentration by impinger were the same for all operations, all the circles would be expected to lie at the ends of the total fiber bars. However, in some operations significant differences can be noted. Fiber preparation is relatively dustier as measured by impinger, while the later operations of carding, twisting and weaving have relatively higher fiber concentrations on membrane filters. It may be that the granular dust which contributes the bulk of the impinger count disperses from the asbestos early in processing while the fibers are dispersed more slowly. The ratios of concentrations of fibers of different lengths are not constant. For example, the total fiber concentration for spinning is much lower than that for twisting but the $> 5 \mu$ fiber concentration is higher for spinning. This illustrates the difficulties in attempting to characterize the exposure to all sizes of fibers by counting only fibers longer than a certain size. The total fibers show more variability from operation to operation indicating they may be a more sensitive measure of relative dustiness.

Some British asbestos textile mills use a concentration of 4 fibers per cc longer than 5μ as a goal in dust control. This is shown on Figure 3 by vertical lines. It would appear from the results reported in this study that the British limits are exceeded, on the average, in all operations. However, their counts are made with vertical illumination on colored membrane filters while in this laboratory counts are made with transmitted light-phase contrast on cleared filters, and therefore the two standards may not be comparable. Further work is in progress to resolve this question.

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ASBESTOS STUDY

CONCLUSION

It should be emphasized that all of the data presented are preliminary and that the results of more extensive studies both in textile and other asbestos processing plants will be reported in the literature as the studies progress. In general, dust concentrations reported to date in this study are considerably below those found by previous investigators in 1934 and 1938. However, improvements in the dressing of crude asbestos may have increased the fiber to particle ratio so that fiber concentrations may not have decreased as much as particle concentrations. Additional data from many different types of plants will be required before the combination of epidemiological and dust concentration data may lead to a new standard of safe levels of exposure possibly based on a new method of evaluation.

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2. Dreessen, W. C., J. M. Dalla Valle, T. I. Edwards, J. M. Miller, and R. R. Sayers (1938). A study of asbestosis in the asbestos textile industry. Public Health Bulletin No. 241, U. S. Government Printing Office, Washington, D. C.
3. Objectives and General Plan for Occupational Health Study of the Asbestos Products Industry. Division of Occupational Health, Public Health Service, Department of Health, Education, and Welfare, August 21, 1962.
4. Industrial Ventilation - A Manual of Recommended Practice, 8th edition. Committee on Industrial Ventilation, American Conference of Governmental Industrial Hygienists, Lansing, Michigan, 1964.
5. Bamblin, W. P.: Personal communication.
6. Ayer, H. E., G. H. Edwards, J. H. Fanney, and J. R. Lynch. Relationship of impinger counts to fiber concentrations by membrane filter in asbestos textile plants. Delivered at the annual meeting of the American Industrial Hygiene Association, Houston, Texas, 1965.

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ASBESTOS STUDY

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TABLE I

DUST CONCENTRATIONS - ASBESTOS TEXTILE SURVEYS

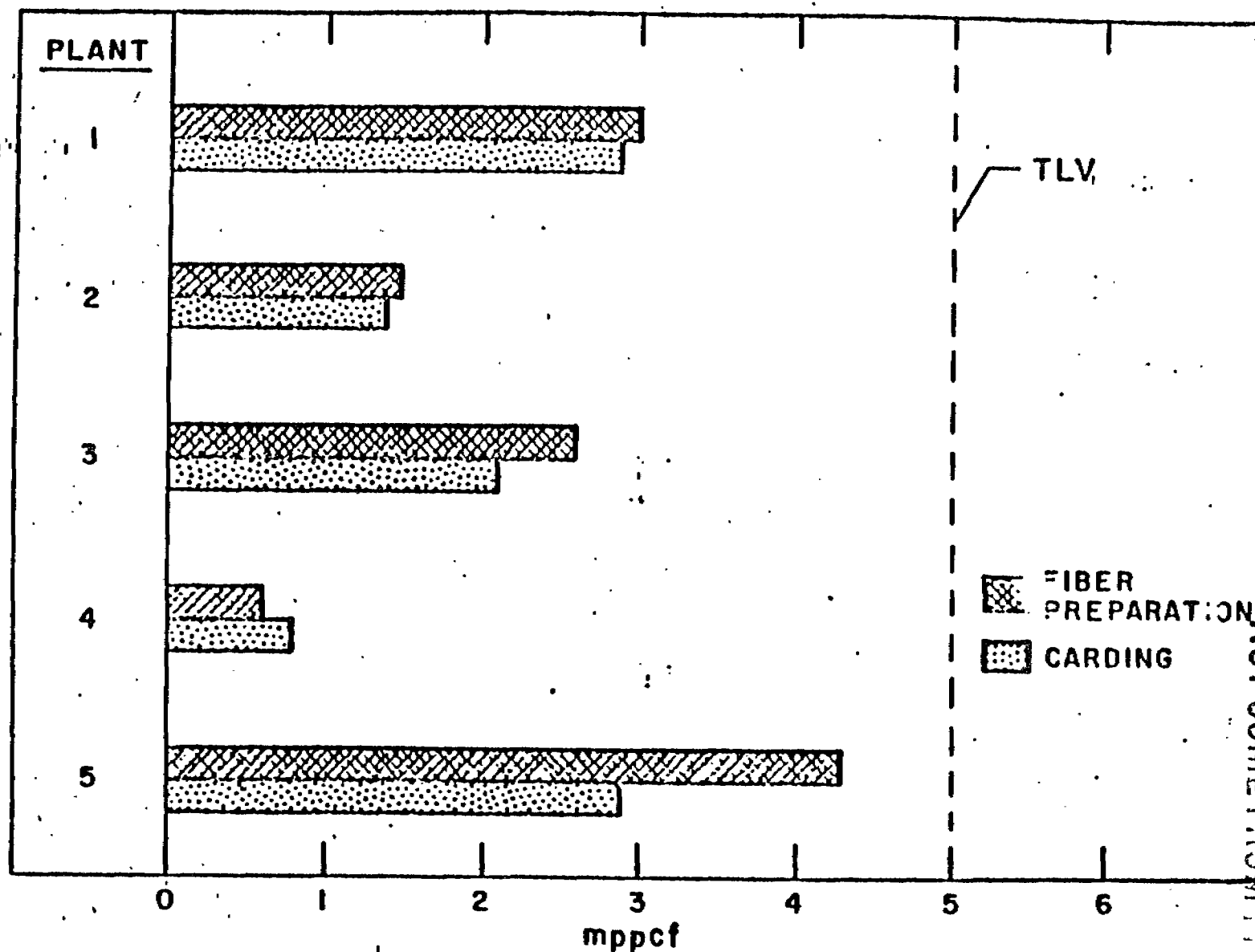
SURVEY OPERATION	Penna. 1934	PHS 1938		Public Health Service 1964
		without control	with control	
Mean Concentration in mppcf				
Fiber Preparation	67.0	36.0	6.0	2.6
Carding	31.1	25.7	3.3	1.7
Spinning	16.2	7.1	---	1.2
Twisting	3.8	11.1	---	1.5
Weaving	19.8	14.0	2.1	1.2

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AVERAGE DUST CONCENTRATIONS BY PLANT AND OPERATION
IMPINGER SAMPLES COUNTED AT 100X

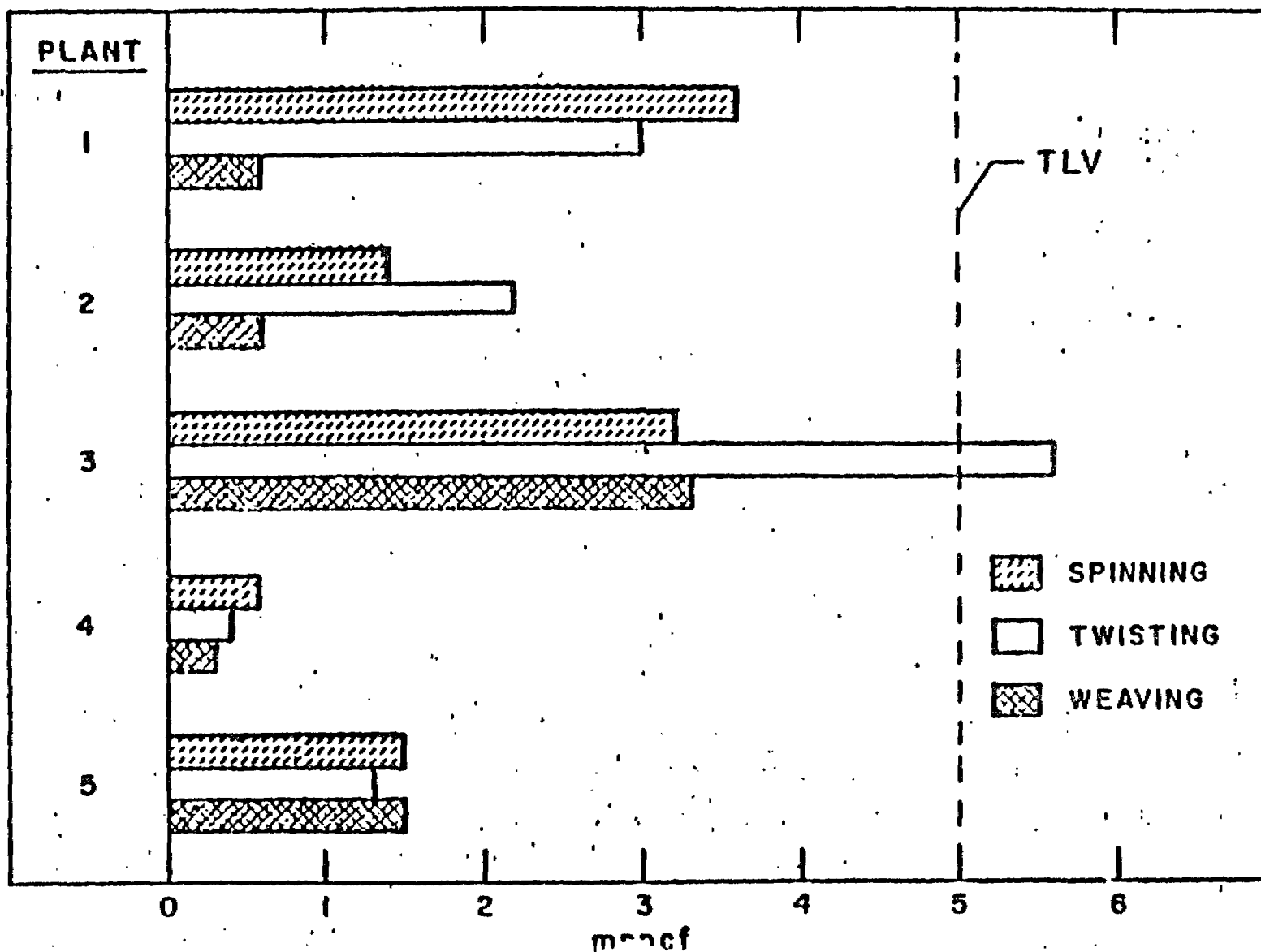
Figure 1

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AVERAGE DUST CONCENTRATIONS BY PLANT AND OPERATION
IMPINGER SAMPLES COUNTED AT 100X

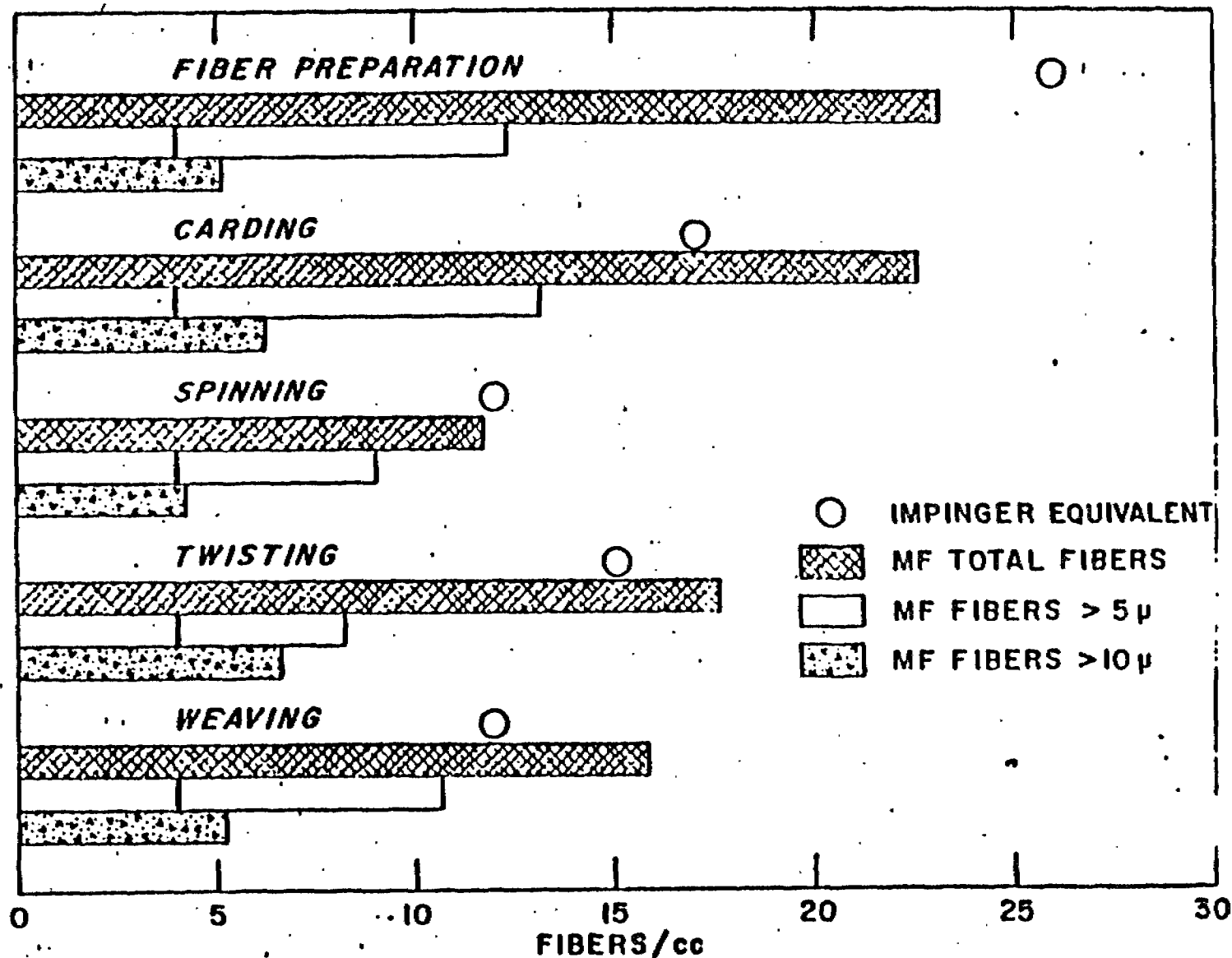
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DUST CONCENTRATIONS BY OPERATION
MEMBRANE FILTERS COUNTED AT 430X PHASE CONTRAST

FIGURE 3

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