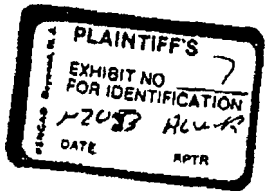
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REPORT TO ASBESTON DIVISION
UNITED STATES RUBBER CO.
HOGANSVILLE, GA.

PRELIMINARY RESULTS

on

2 YEAR STUDY

1957 - 1958

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In late 1956 and early 1957 several informal meetings were held with Mr. A.C. Link, Mr. John Alexander, and Mr. Jim Guy of the Hoganeville, Georgia U. S. Rubber Company regarding the problem of asbestos disease in the Asbestos Plant.

It was learned that continuing efforts had been directed towards increasingly successful dust control since the plant's inception in 1942- to a point where dust count information showed levels in all divisions of the plant generally well below those recommended and accepted as safe levels in the asbestos industry.

Dust count data, collected and counted according to accepted procedures, at intervals of every month or less, from many stations in all compartments of the plant were available since 1942. Checks by independent agencies, such as the State of Georgia Department of Health, The Industrial Hygiene Foundation and the New York office of the U. S. Rubber Company, showed good correlation with the data collected by the plant personnel. Biannual chest x-rays had been taken on all workers and had been read by a radiologic consultant, who submitted his report to the local office of the company. X-rays were taken from the beginning of plant operation and offered in all cases a radiographic history spanning the occupational life history of the worker.

Cases of pulmonary asbestosis were beginning to appear. By late 1956, there were five workers with indisputable signs of pulmonary disease thought to be due to asbestosis.

On the basis of the foregoing information several recommendations were made.

1. A comprehensive study should be undertaken which would attempt to correlate
   a. The workers' general health, and in particular, evidence of pulmonary disease due to exposure to asbestos dust
   b. Roentgenologic findings
   c. Dust count accumulative exposure data measured in MPPCFY (Million particles per cubic foot years)
2. Conclusions should be formulated from these correlations
3. Recommendations should be made to insure protection of the workers from asbestos dust; facilitate prediction and early detection of affected workers; and propose guides for further study.

Complete medical histories were taken on each worker, with particular attention being paid to respiratory and cardiovascular systems. Thorough physical examinations were performed, omitting only the breast and pelvic examinations on females

and rectal examination on males (in all cases patients were advised to have their family doctors complete this part of this examination, lest subsequent negative reports to them by me lull them into false physical security).

Numerous pertinent laboratory studies were made. These included skin tests for tuberculosis (Tuberculin 1 : 1,000) and histoplasmosis (Histoplasmin 1 : 1,000), vital capacity measurements, urinalyses, and complete hemograms. Hemograms were composed of a white blood cell count and differential examination, and determination of red blood cell count, hemoglobin, and hematocrit. Sedimentation rates were obtained in all cases.

Where particular side abnormalities were found, such as pus, blood, sugar or albumin in the urine, or abnormal blood values discovered, tests were repeated, and if verified, patients were referred to their family physician for further diagnosis (if necessary) and treatment.

Three four-film x-ray viewboxes were installed in my office and serial roentgenograms (in some cases dating back to 1942) were examined with particular interest in the appearance of advancing pattern of asbestos disease in those who have developed the disease, and in the x-ray-clinical correlation.

Dr. Eugene Pendergrass, Chief of Radiology of the University of Pennsylvania Medical School and x-ray consultant to the U. S. Rubber Company, kindly spent a day with me at the outset of this study reviewing the radiologic possibilities of pulmonary asbestos disease. His help was invaluable and facilitated this study to a considerable degree.

Dust count data compiled from 1942 through September 1957 were made available. These data were obtained from analyses made by Mr. Jim Guy, Safety supervisor of the Hogansville asbestos plant of the U. S. Rubber Company, and from studies made by the Industrial Hygiene Foundation of America in 1950 and the Institute of Industrial Medicine- New York University- Bellevue Medical Center in 1954.

According to the statistical analysis of January 1954 by the Institute of Industrial Medicine- New York University- Bellevue Medical Center graphs were drawn detailing the average monthly dust counts since 1942 in the various compartments of the Hogansville Asbestos Plant of the U. S. Rubber Company. Dust counts were uniformly high initially in all compartments and highest in the following decreasing order: opening and picking, east carding, weaving, spinning, flyer frames, and winding.

Uniform downward trends of average monthly counts of asbestos dust (measured in MPPCF) were observed in all areas as dust control measures became more efficient.

Monthly dust counts were then averaged out and shown as average yearly totals.

The maximum allowable concentration of asbestos particles of 3-10 micro size has been held to be 5,000,000 particles per cubic foot. This figure has been held to be such that a worker, working a 40 hour week should be able to labor a lifetime at this exposure without developing asbestos disease. There is no clear cut origin of this figure and it may be that it is simply a carry over from the figure held to be safe for the silicon industries.

Using this figure as a basis, The New York-Bellevue group formed charts which showed the following:

Winding:	More than 5 MPPCF 1942-1944; Less than 5 MPPCF 1945-1953
Flyer Frames:	More than 5 MPPCF 1942-1946; Less than 5 MPPCF 1947-1953
Spinning:	More than 5 MPPCF 1942-1946 5MPPCF in 1947-49, less than 5 MPPCF 1950-1953
Weaving:	More than 5 MPPCF 1942-1951; Less than 5 MPPCF 1952-1953
E. Carding:	More than 5 MPPCF 1942-1949; Less than 5 MPPCF 1950-1953
Opening and Picking:	More than 5 MPPCF 1942-1950; Less than 5 MPPCF 1951-1953

The total accumulative exposures in each area has been least in winding and incrementally increased through opening and picking where the greatest average exposure has been and still exists. Continuing dust data now shows the following figures through September 1957:

Winding:	2.0-2.9 MPPCF- depending on location (Most stations average around 2.7)
Flyer Frames:	2.0-2.6 MPPCF- depending on location (Most stations average around 2.6)
Spinning:	3.0-4.0 MPPCF- depending on location (Most stations average around 4.0)
Weaving:	2.0-3.8 MPPCF- depending on location (Most stations average around 2.8
Carding:	2.7-3.7 MPPCF- depending on location (Most stations average around 3.(
Opening and Picking:	3.0-3.7 MPPCF- depending on location (Most stations average around 3.7

One hundred thirty-four worker-patients were examined in 1957. Forty-nine were white males, and seventy-four were white females. Eight were colored males and three were colored females. One hundred twelve worker-patients were examined in 1958. Of these, one hundred seven had been previously examined in 1957 and five were worked up for the first time in 1958.

The twenty-seven patients seen in 1957 but not re-examined in 1958 had left the company or were on leave of absence.

Over the 1957-1958 span one hundred forty-eight people were included in this study. Nine have not been examined but have been included in the study because their x-ray and dust count data are available for examination. Five are new workers and four are patients with definite and known pulmonary asbestosis, who had been returned or transferred elsewhere before the study began. These individuals are , , , and .

Workers were divided by years of accumulative exposure in the following manner with the following findings. No attempt was made to separate different job classifications in this series.

0-5 years — Forty-seven workers ranging from 2 months to five years in Asbestos and with total accumulative exposure ranging from 0.3- 2.0 MPPCFY. No evidence of asbestos pulmonary disease was found. Several other conditions were uncovered- Two patients with diabetes mellitus, one with probable congenital cholelithiasis, one with rheumatic heart disease, and three with pulmonary hypertension suspected on basis of loud second pulmonic sound; and several with rather severe anemia usually due to menorrhagia and inadequate diet. Two patients with essential hypertension were discovered and treatment recommended or encouraged.

Of these forty-seven, twenty-two were white males; twenty-two were white females; two were colored males; and one was a colored female. One was from opening and picking; twelve from carding; five from flyer frames; four from winding; nine from spinning; and thirteen from weaving. One patient, , 46 WM from Weaving with accumulative exposure of 4 MPPCFY has a chest x-ray which is probably normal but which shows minimal suspicious signs.

6-8 years — Thirty-five workers ranging from 5.5 to 8 years in asbestos and with total accumulative exposure ranging from 13.2 to 47.9 MPPCFY. One patient, , 52 CM of opening and picking with 7 years and 47.9 MPPCFY has definite evidence of pulmonary asbestosis. Five patients have equivocal but suggestive early evidence of pulmonary asbestosis. These are , 39 WM of winding with 6.5 years and 22.4 MPPCFY; 52 WF with 8 years and 25.6 MPPCFY; Lois Hurtt, 46 WF of winding with 7.0 years and 21.8 MPPCFY; , 35 WM of winding with 8 years and 35.4 MPPCFY; and , 36 WF of spinning with 6 years and 24 MPPCFY. is definite. The other five must be regarded with suspicion, and watched closely.

Several other conditions were found. Nine patients (six from winding, two from spinning, and one from flyer frames) had histories of recurrent sinuso-trachao-bronchitis. Only one, _____, showed any suspicion of pulmonary asbestos disease. Two patients with hypertensive cardiovascular disease and one with hypertensive vascular disease were found; one with non-toxic nodular goiter; one with low grade chronic urinary tract infection; and three with moderately severe anemia (below 10.0 grams %) were found. Patients were informed and advised in all instances to consult their family physicians.

Of these thirty-five, ten were white males; twenty-three were white females; two were colored males.

Two were from opening and picking; two from carding; six from flyer frames; five from spinning; eighteen from winding; one from weaving.

One patient with definite early asbestosis is from opening and picking. Of these with suspicious signs one each is from weaving, flyer frames, winding, and spinning.

9-10 years

Twelve workers ranging from 8.5- 10.0 years in asbestos with total accumulative exposure ranging from 27.4 to 74.9 MPPCFY.

One patient, _____, carder, 51 WM with 10 years and accumulative exposure of 38.0 MPPCFY has definite early radiologic evidence of pulmonary asbestosis. One other, _____, 41 CM of opening and picking with 9 years and 54.1 MPPCFY total accumulative exposure has shown equivocal early radiologic signs of pulmonary asbestosis together with decreasing vital capacity and rising red blood cell count during the past year.

Other conditions found included two with recurrent bronchitis and bronchiolitis but with no evidence of asbestosis; two with asymptomatic hypertensive cardiovascular disease and one with essential hypertension; two patients suffered with recurrent urinary tract infections and one gave a history of peptic ulcer with hemorrhage. These patients were appraised of their conditions and advised to consult their family physicians for further care Of these twelve workers four are white males, seven are white females, and one is a colored male.

One is from opening and picking, one from carding, three from flyer frames, one from spinning, two from winding, and four are from weaving.

The patient with definite asbestosis is from carding; the one with equivocal early changes is from opening and picking.

11-12 years

There are twenty-one workers with 11-12 years experience with total accumulative doses ranging from 36.0 to 118.5 MPPCFY.

Of this group only seven present no radiologic evidence of pulmonary asbestosis and three of these seven must be regarded with suspicion because of increasing red blood cell values, early clubbing, or changing intensity of the second pulmonic heart sound.

Of the remaining fourteen, eight have unequivocal - and in several cases advanced cases of pulmonary asbestosis; four have equivocal early changes and two have minimal and questionable early signs.

Six of this group have previously been discovered and transferred to other sections of the Hagerville Plant. Theirs are the most advanced cases. They are [redacted], 45 WM weaver with 12 years and 58.2 MPPCFY; [redacted], 45 WM carder and fly frame tender with 11 years and 56.0 MPPCFY; [redacted], 64 WM with 12 years and 62.6 MPPCFY; [redacted], WF spinner with 11 years and 118.5 MPPCFY; [redacted], WF weaver with 12 years and 100 MPPCFY; and [redacted] WF spinner with 12 years and 73.2 MPPCFY.

Of the remaining eight, [redacted], 59 WF weaver, has 11 years and 56.6 MPPCFY and [redacted], 42 WM winding and weaving supervisor, has 11 years and 41.5 MPPCFY.

Of the early equivocal patients, [redacted], 52 WF weaver, has 12 years and 79.3 MPPCFY; [redacted], 47 CM opener and picker, has 11 years and 58.7 MPPCFY; [redacted], 48 WF winder, has 12 years and 42 MPPCFY; and [redacted], 45 WM overseer in carding and spinning, has 12 years and 51.2 MPPCFY.

The more equivocal, but early suspicious patients include [redacted], 42 WF fly frame tender with 12 years and 42.3 MPPCFY and [redacted], 52 WM assistant overseer in carding and spinning, 12 years and 51.2 MPPCFY.

Of the total group few unrelated medical conditions were discovered. One patient had asymptomatic hypertensive cardiovascular disease; one suffers with recurrent bronchitis (but has no evidence of asbestosis), one has active smouldering rheumatoid arthritis; and one has had renal calculi since being removed from the Asbestos Plant.

Of the twenty-one workers, eight are white males; twelve are white females; and one is a colored male.

One is from opening and picking; three are from carding; four are fly frame tenders; four are from spinning; four from winding; five from weaving; four are in supervisory capacities.

Of the eight patients with definite asbestosis two are from winding; one from weaving; three from spinning; one from carding; one is a supervisor in weaving and winding. Of the other six; one from opening and picking; one is a fly frame tender; one from winding; one from weaving; and two are in overseeing capacities in carding and spinning.

13-14 years

There are fourteen workers ranging from 12.5- 14 years in asbestos and with accumulative exposure from 41.4 to 125.6 MPPCFY.

Of this group seven appear free of the disease. Of the remaining seven, [redacted], WF spinner with 13 years and 125.6 MPPCFY, has been previously transferred. Two others show unequivocal signs of pulmonary asbestosis. They are [redacted], 54 WM carder with 13 years and 74.0 MPPCFY and [redacted], 35 WF spinner with 12.5 years and 62.1 MPPCFY. Four have equivocal early changes. They are [redacted], 47 WF weaver with 13.0 years and 41.4 MPPCFY; [redacted], 51 WF frame tender with 13.5 years and 56.7 MPPCFY; [redacted], 43 WF frame tender with 14.0 years and 76.6 MPPCFY; and [redacted], 62 WM weaving supervisor with 14.0 years and 112.4 MPPCFY.

Other conditions found included two with chronic and recurrent bronchitis; one of whom has early suspicious asbestosis, one with leg vein thrombophlebitis and suspected recurrent pulmonary emboli; one with acute glomerulonephritis, one with virgin diabetes mellitus, and one with hypertensive cardiovascular disease.

Of these fourteen, four are white males; ten are white females; four are from spinning; one from winding; one from weaving; and one is an office secretary. There is one overseer from weaving and winding.

14 + years

There are nineteen workers in this group ranging from 14.5 to 16 years and with accumulative exposure from 52.5 to 175.0 MPPCFY.

Of this group, eight are free of the disease although one has equivocal clubbing of finger nails.

Of the remaining eleven, two have already been removed from the asbestos plant. They are [redacted], 39 WM spinner and supervisor with 15 years and 175 MPPCFY and [redacted], 43 WM carder with 13.5 years and 98.6 MPPCFY. Of the remaining nine, four have unequivocal early pulmonary asbestosis. They are [redacted], 54 WF winder with 15.0 years and 53.4 MPPCFY; [redacted], 54 WF weaver with 15 years and 101.4 MPPCFY; [redacted], 44 CM from opening and picking with 15 years and 128.6 MPPCFY (has been removed from asbestos); and

, 32 WM spinner with 15 years and 83.8 MPPCFY. Five others with early suspicious changes are , 43 WF with 15 years and 63.5 MPPCFY; ., 41 WF winder with 15 years and 52.5 MPPCFY; , 40 WM carder with 16 years and 71 MPPCFY; 57 CF weaver and sweeper with 15 years and 101.4 MPPCFY; and , 38 WM spinner with 15 years and 83.8 MPPCFY.

Other medical conditions found include one patient with chronic bronchitis; four with hypertensive cardiovascular disease and two with essential hypertension; one with severe anemia; and one with intermittent claudication due to peripheral arteriosclerosis.

Of the twenty-one patients, eight are white males; seven are white females; two are colored males; and two are colored females.

In summation; of one hundred forty-eight patients, nineteen patients have definite and unequivocal early to advanced pulmonary asbestosis; sixteen have equivocal early evidence of the disease; and four have slightly suspicious changes. A total of thirty-nine in all.

Of these thirty-nine, four are from opening and picking; four are from carding; four are from flyer twisters; ten from spinning; seven from winding; and five are from weaving. Two are in supervisory capacities in carding and spinning; two in winding and weaving; and one in carding and fly frames.

Chart # 1 shows a distribution of patients with varying degrees of accumulated exposure. There are two patients with ? $\pm$ changes with 21.8 years and 24.0 MPPCFY; and two $\pm$ with 22.4 years and 25.6 MPPCFY; one patient with one $+$ changes at 38 MPPCF; one with ? $\pm$ change at 42 MPPCF; and two with $\pm$ changes at 41 and 42 MPPCFY. There is one with one $+$ changes at 47.9 MPPCFY. The remainder begin to bunch at 50 million particles per cubic foot years and show no particular dose-severity relationship until 90 MPPCFY is exceeded. Even here one is $\pm$; two are one $+$; one is two $+$; and four are three $+$.

Most of those from winding and opening and picking who show involvement do so before they have a total accumulate exposure of 60 MPPCFY.

Weaving, spinning, carding, and flyer frames tenders are strewn out in random fashion from an accumulative exposure of 60 MPPCFY on.

CHART # 1

Million Particles Per Cubic Foot Years (MPPCFY)

1-29	30-40	41-45	46-50	51-60	61-70	71-80	81-90	91-100	100 +
+ 21.8W 24.0 S		42FF		51.2 C&S					
22.8W 25.6FF		42W 41WE		51.2 C &S 54.OP 58 OP 54.7 FF 52.5 W	63.5FF	79.8 WE 71 C 76.6 S	83.8 S		101.4 WE 112 WE & W
+ 38 C		41.5 WE & W	47.9 OP	56 WE	62 S		83.8 S		101.4 WE 128 OP 118 S
+				53 W		74 C		98.6 C	
+				58 W 56 C & FF	62.6 S	73.2 S			138 S 100 W 125 S

OP - Opening and Picking
C - Carding
FF- Flyer Frames
S - Spinning
W - Winding
WE - Weaving

There are 6 patients with 3 + asbestosis. They are as follows:

Column I (Sept. 1957)	Column II	Column III
(S) 138.7	Jan. 1950	110.7 MPPCFY
(FF & C) 56.0	Jan. 1953	44.0 MPPCFY
(S) 62.6	Jan. 1955	
(W) 100	Nov. 1949	45.0 MPPCFY
(W) 58.2	Sept. 1956	55.3 MPPCFY
(S) 125.6	?	

Review of their x-rays shows that definite 1 + changes occurred as noted under Column II.

Their total accumulative exposure corrected to the time of first roentgenologic changes is listed under Column III.

As can be readily observed, three of these patients continued at risk for several years after first definite signs of the disease and worsened rather rapidly.

Two patients were detected fairly recently, yet by the time of removal 2 and 1 years later had shown rapid progression of the pulmonary lesion, despite low continuing exposure rates brought about by improvement of plant filtering and exhaust protection.

There are 3 patients with 2 + asbestosis. They are as follows:

Column I (Sept. 1957)	Column II	Column III
74.0 C	Jan. 1956	68.0 MPPCFY
98.6 C	Aug. 1953	86.6 MPPCFY
53.4 W	Jan. 1957	50.7 MPPCFY

All patients with 1 + or ± pulmonary asbestosis have begun to develop pulmonary and/or clinical hematologic changes within the past year.

II

Discussion and Conclusion

Pulmonary asbestosis is a disease of the lungs caused by exposure to and inhalation of particles of asbestos dust. The particulate size is important and probably varies from 3 to 10 microns. The finding that patients in the winding section tend to develop pulmonary signs at lower accumulated exposure rates than workers in other sections (the total gross exposure rate being roughly equivalent) suggests that the dust size at the winding stations may be different or perhaps that the velocity of scattered dust may be greater with resultant greater pulmonary penetration.

Microscopic studies elsewhere have shown that the anatomic changes in the lung consist chiefly of perivascular fibrosis, interstitial fibrosis, and thickening and widening of the alveolar capillary barrier. There is additionally a marked pleural and pericardial fibrotic reaction.

The clinical course of observed patients with pulmonary asbestosis has been insidious and marked by slowly progressive loss of strength, pep, and energy, and sense of well being. Patients tend to develop a dry hacking, usually non-productive, cough with associated sticky pains across the lower areas of the chest both anteriorly, posteriorly, and in the axillae. Breathing ability becomes markedly diminished, but usually so slowly that patients almost automatically adjust to it and usually comment that their wind is adequate if they don't hurry or strain. There have been no instances of overt right sided heart failure due to increasing pulmonary blood pressure.

In several instances, patients have complained most prominently of indigestion and epigastric and hypochondral discomfort, sub-sternal burning and frequent eructation, but without nausea or vomiting. There have been no instances of pulmonary hemorrhage or spontaneous pneumothorax.

Several patients show varying degrees of dorsal kyphosis and/or kypho-scoliosis. Others show varying degrees of pectus excavatum. These anatomical chest changes have so far shown no relationship to the individual workers' susceptibility to pulmonary asbestosis.

So far there have been no suspected or proven cases of pulmonary tuberculosis or bronchogenic carcinoma either in the workers with asbestosis or in those with no evidence of the disease.

There is a relatively high incidence of patients with various combinations of sinuso-pharyngo-tracheo-bronchio-bronchiolitis. These patients have not so far shown any evidence of increased susceptibility to asbestos disease.

On the objective side all patients with unequivocal pulmonary asbestosis have shown varying degrees of radiographic changes. (See below.) These have occurred at widely varying total accumulative dust doses and have no significant relationship to age, sex, or race. (However, the high colored case rate is related in all probability to the higher dust exposure rate of their particular jobs.)

All patients with pulmonary asbestosis show significantly diminished vital capac (measured roughly by McKesson-Scott Vital Capacity Apparatus). No attempt has been made thus far to secure timed vital capacities, spirograms, maximal breathing capacities, diffusion rates, or oxygen and carbon dioxide pressure and saturation studies.

Many patients with pulmonary asbestosis have developed varying degrees of clubbing, the extent of which bears no significant relationship to the extent of the x-ray changes. In fact, in a few workers suspicious early signs of clubbing have occurred without simultaneous x-ray changes. While clubbing may occur congenitally and under a variety of other clinical conditions, it must here certainly be regarded as a suspicious sign and the patient watched more closely.

Sooner or later, in patients with radiographic changes of asbestosis, auscultatory signs of pulmonary hypertension develop; that is to say, the second pulmonic sound increased in intensity and ultimately becomes louder than the second aortic sound. In some instances this finding has (and/or is) occurred without as yet parallel radiographic changes. As noted above no patient has as yet developed sufficiently severe or protracted pulmonary hypertension to manifest signs of right sided heart failure; and electrocardiograms have thus far been significantly innocent of changes suggesting right sided heart strain and/or enlargement.

There tends to be a parallel rise in red blood cell, hematocrit, and hemoglobin values with development of a moderate secondary poly cythemia. Red cell counts may rise to 6.5 million per cmm.; hematocrits to 52-56 volumes %; and hemoglobin from 16-18 grams per cent. With progression of the lung disease these values tend to return towards and in some instances go below normal.

Radiographic changes observed through the study of serial x-rays on thirty-nine patients with certain or suspected pulmonary asbestosis have shown the disease to be typified by progressive changes involving the lower lung vascular and interstitial structures with progressive diminution in lung volume as suggested by decrease in vertical dimensions of the lung fields and involvement of the pleuro-pericardial surfaces with eventual obliteration of the costophrenic and cardiophrenic sinuses. Usually as the picture develops emphysematous changes begin to appear in the upper lung fields.

The earliest changes involve either the serous surfaces or blood vessels and are marked by a fuziness or shagginess of the pleuropericardial outlines; or by an appearance of thickening haziness and nodularity of the vascular outline in the lower lung fields. Neither lung seems to be predominately selected and the involvement may be either medial or lateral.

At about the same time, and in some instances even before, there begins to be a decrease in vertical lung dimensions (as measured from the first costochondral juncture to a line extended from the highest point on the diaphragm.

Thereafter the changes involve progressive thickening of the vascular shadows with eventual coalescence; progressive thickening and irregularity of the pleuropericardial outlines; and progressive diminution in the total lung volume as suggested by decrease in apical-diaphragmatic distance.

For the purpose of this study the following catagorical classification was established:

0	No evidence of disease
$\pm$	Equivocal changes suggesting one + but insufficient for definite statement
1 +	Initial furring or shagginess of pleural or pericardial surfaces or initial thickening and haziness of vascular outlines
2 +	Combination of vascular and pleuropericardial changes with possible early decrease in vertical chest dimension
3 +	Changes previously noted plus development of background reticulation or ground glass appearance in lower lung fields, coalescence of vascular patterns, further thickening of pleuro-pericardial outlines and greater decrease in vertical dimensions of chest.
4 +	Almost solid appearance of one or both lower lung fields plus all of above changes

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Nineteen patients were classified as having definite pulmonary asbestosis. All nineteen have definite and unequivocal radiographic changes compatible with the criteria previously established. (See page 13.) Of these nineteen, fifteen have been personally seen in this study. Of these fifteen all have diminished vital capacities and twelve of the fifteen show decreasing vital capacities. Similarly twelve show some evidence of high or rising red blood cell values.

Eight of these fifteen patients show varying degrees of clubbing and eight show evidences of increasing pulmonary blood pressure.

Twenty patients have plus-minus radiographic changes according to the criteria established in this study. Sixteen of these patients show decreasing vital capacity measurements, thirteen show rising red blood cell values, four reveal increasing intensity of the second pulmonic sound; and one shows definite early clubbing.

A definite diagnosis of pulmonary asbestosis cannot be made, under the conditions of this study, without radiographic changes. However, the appearance of any combination of decreasing vital capacity, rising red blood cell values, increasingly loud second pulmonic heart sound or clubbing should be considered a suspicious sign in any asbestos worker; and that worker should henceforth be watched closely for further pulmonary asbestosis evidence.

That workers on any area within the Asbestos plant can develop pulmonary asbestosis is abundantly clear.

Chart # 2 (page 15) shows a break down of workers by sections plotted against years of employment in Asbestos.

This chart suggests that workers in opening and picking are at greatest risk, 44% of nine workers having developed either definite or suspicious signs of asbestosis. Chart # 1 suggests moreover that these workers are apt to develop signs of asbestosis at a lower total accumulative dosage than employees in other divisions of the plant.

Employees from SPINNING are next most frequently involved. Forty-two % of twenty-six workers have definite or suspicious signs and twenty-seven percent have definite asbestosis. Inspection of Chart # 1, however shows that all seven workers with definite disease have a total accumulative dose of over 60 MPPCFY; and that all but one with suspected disease has an accumulative exposure of over 50 MPPCFY.

Employees from CARDING are third most frequently involved percentage-wise. Two are carders with over 70 and over 90 MPPCFY total dose and one is a fly frame-carding supervisor. One patient, however, has an accumulative dose of only 38 MPPCFY. The relatively small number of workers from the carding section with asbestosis may well relate to the fact that this population is young in regard to working years and total accumulative dosage.

Twenty-four percent of thirty-four workers from WINDING have definite or suspicious evidence of pulmonary asbestosis. Four are definite and four are suspect. Of interest here however, is the fact that six of these eight (three from each group) have developed signs at somewhat lower total exposure doses than comparable individuals in other sections. Yearly dust studies (See page 3) show the winding section to have one of the best dust control systems in the plant. These data raise a possibility that the characteristics of the dust in this section (e.g. size, velocity) may have a bearing on making the winding section somewhat more hazardous.

WEAVING is next with twenty-three percent of twenty-nine workers. However fifteen workers have been on the job less than five years. There is a wide spread in total accumulative doses in involved patients in this section ranging from 40 MPPCFY to over 100 MI

CHART # 2

Number of Workers BY COMPARTMENT

In Years	OP	C	FF	S	W	WE	Supervisor and Secretary	Total
0-5	2	12	5	9	4	15	0	47
6-8	2	2	6	5	18	1	1	35
9-10	1	1	3	1	3	3	0	12
11-12	1	2	5	4	4	5	0	21
13-14	1	2	3	4	2	1	1	14
Over 14	2	4	2	3	3	4	1	19
Totals	9	23	24	26	34	29	3	148
Number with Asbestosis	2	3	1	7	4	2	0	19
% Workers Asbestosis	22%	13%	4%	27%	12%	8%	0	
Number with Suspected Asbestosis	2	3	3	4	4	4	0	20
% of Workers with Suspected Asbestosis	22%	13%	13%	15%	12%	17%	0	
Number of Workers with positive or suspected Asbestosis	4	6	4	11	8	6	0	39
% of Workers with positive or suspected Asbestosis	44%	26%	17%	42%	24%	23%	0	

Only four of twenty-four FLY FRAME TENDERS have any evidence of asbestosis. However, all of these show signs of the disease at total doses under 70 MPPCFY and two of them are under 45 MPPCFY. This section has one of the best records in regard to dust control. The evidence would suggest however, that those workers who will develop asbestosis in this section will tend to do so earlier than in most other sections.

III

RECOMMENDATIONS

Pulmonary asbestosis is an industrial health and preventive medicine problem of the first magnitude.

This study suggests that the primary and most important factor in acquiring the disease is the individual worker's total accumulative exposure to asbestos dust.

Previous safe level figures of 5 MPPCF per year must be revised radically downward; the only concession short of an ideal zero exposure being the minimax relationship of diminishing returns versus increasing effort and expense.

An active program of education of the workers should be undertaken to alert them not only to the danger inherent in the job; but also to the company's effort towards eliminating the asbestos dust exposure hazard and early detection of affected workers. This program should be energetic forthright and continuous. It should include not only the asbestos workers, but their families, the remainder of the working body of the Hoganeville plant, and the community as a whole.

Accumulative dust exposure figures should be kept current and readily available on all workers. Consideration should be given to posting section figures, by the month, in the involved areas and inviting workers' suggestions regarding methods of lowering the dust hazard. (One who is on the daily job may have some pretty good practical ideas.)

Chest x-rays should be taken- as is now customary,on all new workers and on workers returning from layoffs, illnesses, and leaves of absence. Otherwise x-rays need only be taken at twelve intervals until the worker has reached a total accumulative dose of 20 MPPCFY.

Thereafter, (above 20 MPPCFY) chest x-rays should be taken every 6 months.

Clinical evaluation should be done during the first, third, and fifth years of the worker's employment; and thereafter, every year.

It would be of great interest and value if more extensive studies could be undertaken regarding the nature and degree of incapacity of those patients with demonstrated or suspected asbestosis. The information acquired would be of both medical and medico-legal significance.

If the information we now possess is properly utilized, no worker need ever progress beyond minimal early changes of asbestosis before he is detected and removed to a less hazardous environment.

If the yearly accumulative exposure dose is progressively lowered, it should mean that a given worker will be able to stay on the job much longer and at less risk to all concerned.