NIOSH 00117758

INDUSTRIAL HYGIENE SURVEY

OF

GRANITE MONUMENT, MEMORIAL,

AND

BUILDING STONE INDUSTRY

IN

TEXAS

Plaintiff's Exhibit
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1939

TEXAS STATE DEPARTMENT OF HEALTH
DIVISION OF INDUSTRIAL HYGIENE
AUSTIN, TEXAS

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Acknowledgments

The State Department of Health wishes to acknowledge with thanks the splendid interest, cooperation, and assistance it received from employers and employees of the granite, monument, memorial, and building stone industry in Texas in an Industrial Hygiene survey of this industry. Without such help and cooperation, this study could not have been made.

The Department sincerely hopes that this survey reveals some interesting facts and in some measure assists in promoting an understanding of, and an interest in, the potential ill effects of occupation on health.

GEO. W. COX, M. D.
State Health Officer

INDUSTRIAL HYGIENE SURVEY OF GRANITE, MONUMENT, MEMORIAL AND BUILDING STONE INDUSTRY IN TEXAS

Introduction

Some months ago, the Division of Industrial Hygiene of the Texas State Department of Health completed its preliminary survey of a cross-section of representative industries in the MANUFACTURING, MECHANICAL, AND MINERAL industry; TRANSPORTATION and COMMUNICATION; DOMESTIC and PERSONAL service. This study covered 1254 plants employing some eighty-eight thousand (88,000) people and was made for the purpose of locating potential health hazards arising out of, or associated with, the nature of the work of the employees. Personal visits were made by an engineer and/or a physician who attempted to familiarize himself with the materials used, processes involved, by-products, finished products, environmental conditions, and general plant sanitation. These surveys led to the compilation of certain data (1) which were projected to cover the entire employed population in the classifications named and led to the conclusion that in Texas employees in industry are exposed to

many potential health hazards for which there are no attempts made for control. It must be emphasized that THIS ORIGINAL SURVEY REVEALED ONLY POTENTIALITIES AND DID NOT IN ANY WAY IMPLY ACTUAL INJURY. Based upon this survey, there are exposed to silica dust in Texas industry some thirty thousand (30,000) or more people.

In the report of this preliminary survey it was stated that more detailed studies would have to be made of the potential hazards before any definite statements could be made relative to the reality and seriousness of the potential hazards.

THERE IS IN TEXAS NO COMPENSATION FOR OCCUPATIONAL DISEASES. The courts have definitely ruled against such an interpretation for industrial accidents. There have been several liberal interpretations, however, for which we can offer no explanations.

The detailed studies necessary must cover not only the environmental conditions, but also the health of the workers. They require engineering, chemical, and medical investigations. The study covered in this report was brought about by the fact that early in our general preliminary surveys our attention was called to "silicosis." The question

was asked whether the condition is really to be found in Texas and whether it is a problem. Potentially, as stated, thirty thousand (30,000) or more workers are exposed to siliceous dusts, the inhalation of which may lead to silicosis, a chronic disease usually occurring only after an exposure of ten years or more. Occasionally, however, an exposure of two years or less is sufficient. The amount of free silica in the dust, the amount of the dust, the size of the dust particles, and individual susceptibility all play a part. For some unknown reason the inhalation of this dust leads to the replacement of normal useful lung tissue by a useless scar tissue. This reduced amount of lung manifests itself in a shortness of breath which is the outstanding symptom and complaint.

After this disease has begun, it is difficult to stop even though the individual is removed from the dust exposure. The important factor to consider, however, is the susceptibility of people with silicosis to tuberculosis, and the rapidity with which they succumb to this disease. Indeed a very large percentage of all those with silicosis die of silico-tuberculosis.

Silicosis is a disease which can and must be prevented. Only when employers and workers begin to realize this, however, will anything helpful be accomplished. It is hoped that this study may impress these groups with these facts and if it leads to saving the life of only one person through prevention of silico-tuberculosis, it will have been worth while.

With the approval of the owners of monument, memorial, and building stone quarries and plants, a study of the granite industry was decided on. It should be stated early that this study was not intended to be a complete and detailed research study, but that it would be complete enough so that the results could be of practical value to the industry.

The granite, monument, memorial, and building stone industry is not a major industry at the present time; but we believe that in years to come it will assume major proportions due to the large and easily accessible granite deposits. The industry furnishes an opportunity for the practical application of industrial hygiene methods of study.

In Texas we have plants employing from one to sixty people. Some plants have their own quarries; others buy their stone already cut to size and almost completely finished except for lettering. The average plant buys rough stone which it cuts, surfaces, polishes, and letters.

Our preliminary surveys lead us to believe that in Texas there is very little attempt made to control the potential dust hazard. It seems to be generally believed that the types of sheds used are not conducive to accumulations of dusts. Much of the work is actually done out doors. The usual shed is narrow and runs east and west in the longest direction (See Fig. No. 1). The south side is usually entirely open and the north side has openings which can be used. It is believed that in the summer the prevailing south winds blow the dust out on the north side and in the winter the north wind blows the dust out on the south side.

There have been a number of workers known to have silicosis with or without infection; but it is believed that such conditions are seen most frequently in stone workers who have migrated here from the East where they have worked in closed sheds under conditions which were more conducive to the development of silicosis. It is also felt that these workers have come south to prolong their lives and that they are the ones we hear of as dying because of silicosis or silico-tuberculosis.

Purpose

We have attempted to make studies to determine the degree of the hazard as it exists in our shops. Our study has covered fourteen shops where manufacturing is done and includes not only determinations as to the quantity, type, and source of dust, but also chest x-rays of the men who were exposed to dust in the various plants, together with occupational histories. The fourteen shops which were selected represent a cross-section of the industry and conditions in them are average for the industry.

It is felt that our survey will serve a useful purpose in:

1. Informing the employer regarding health conditions in his plant.

2. Giving the employer and employee simple and correct information regarding the probable relationship between silica dust and the disease, silicosis, thereby correcting false impressions and fears which might exist.

3. Finding the incidence of silicosis among our granite workers.

4. Acquainting the personnel of the Division of Industrial Hygiene with normal working conditions, materials

used, and processes involved so that they might be better prepared to give information and make recommendations for hazards existing.

It should be emphasized that neither employer nor employee was given specific information of the x-ray findings in any employee unless the request was made by both and the information given to both at the same time. The employer, however, was given general information as to the percentage of his employees showing evidence of pathological injury as revealed by the x-ray as well as specific information as to the amounts of dust to which the employees were being exposed in various locations in his plant. The employee was not given this latter information. This policy was followed in order to be fair to both the employer and employee so that there would be no cause for ill feeling resulting from our surveys. In our opinion the plan was well received and both employer and employee felt free to "talk" since they knew that any information they might give us would be treated as confidential and that our studies were of a "fact-finding" nature.

Process of Manufacturing

In order that one may understand how much time and effort are spent in the manufacture of memorials and monuments,

It is necessary to visit the granite quarry and observe that even with the present crude type of methods and use of various equipment there still exists a crude means of removing the stone from the earth. To see the equipment used, to watch the granite quarried, and then to find that only about ten per cent (10 %) of the material is suitable for use is certainly convincing of the slow and difficult process of quarrying usable stone.

The stone is usually cut to the desired size at the quarry or at the monument plants near the quarry. Very few plants--as a matter of fact, only one of the fourteen (14) plants surveyed in Texas--actually cut stone.

The bulk stone is chipped by means of a sledge hammer and large chisel to level the surface and cut down near the outline of the finished product. The stone is then worked with the surfacing machine (See Fig. No. 2) to roughen it down to its approximate shape. To obtain a smoother surface and to shape the outline of the product, the pneumatic hand tool (See Fig. No.3) is employed. Polishing is done after the smooth surface has been obtained, and the lettering is accomplished either by sandblasting of indented letters or by using the pneumatic tool for raised letters.

Most of the plants in this state are of the open type, only one is entirely a shed (See Fig No. 4). There are

no mechanical control methods for the removal of dust except at the sandblasting operation (See Figs. No.5 & No 6) Seven of the fourteen plants have enclosed sandblast rooms equipped with exhaust fans for removal of the dust In most instances these rooms are not air-tight and dust can escape from them through cracks in the walls and ceiling. But in all but one instance the dust is blown just outside the shed where it becomes either a nuisance to the neighbors or may be blown back into the shed through openings. The sand blasters in all of the plants are furnished protective helmets and respirators of varying types. Respirators and goggles are available in most instances to "cutters." But usually they are not being used either because of the discomfort attending the use or because the employee has never recognized the hazards to which he is being exposed. A damp sponge in each nostril or a handkerchief covering the nose and mouth are the most common methods practiced for control, but even these are not usually used

Very few of the plants surveyed have artificial means of lighting, and only one operates at night, doing only sandblasting at that time. The majority of the plants employ from three to nine men, no one having a specific duty to perform. Since the population of the plants is small and operating conditions are seasonal, it is necessary that each man be capable of performing all operations with the exception of designing and

[illegible] There are usually one or two special men for this work

Dust determinations are of value for two reasons: one, because they serve as a method of estimating the degree of exposure in dusty atmospheres; two, for determining the efficiency of various dust control equipment. From an analysis of this survey it can be seen that the value of dust determinations in this state is that they serve only as a method of estimating the degree of exposure to dusty atmospheres. All of the fourteen plants surveyed, with the exception of one, are of the open type. The only control equipment used is exhaust fans in enclosed sand blast booths. Therefore, a comparison of counts with and without the use of control devices could not be made, except at the sand-blasting operation.

Dust Counts--Procedure

The Division of Industrial Hygiene has, as part of its equipment, a truck and a trailer of the house type, as illustrated (See Fig No 7) Considering the great distance between plants in Texas and the time it was necessary to spend at each plant, most of the laboratory work had to be done in the field with the exception, of course, of chemical analyses The trailer

was first used for roentgenological examinations and film develop-ing. Recently it has been successfully used as a laboratory for dust determinations.

Dust sampling was done with the Greenburg-Smith type of impinger (2). An electrically driven suction apparatus and/or a compressed-air suction apparatus, or ejector, pulling one cubic foot of air per minute through a fifty per cent solution of alcohol in distilled water, were used. The ejector was used in the majority of the plants because of its convenience in handling and because of accessibility to air connections.

In making the dust counts, a modified cell similar to the Sedgwick-Rafter counting cell and containing exactly one cubic centimeter of solution was used. A specially constructed micrometer (a steel washer upon which were sealed two hair, one parallel to the other) was used in the ocular of the microscope in place of the Whipple Disc. The area of the field produced by the parallel hair was determined by calibration with a micrometer scale. Two micro-scopes, having suitable eye pieces, objectives, and each equipped with a condenser, were used with 100 X magnification for the dust counting. This equipment and the method of its use were in accord-ance with the standards adopted by the United States Public Health Service (2).

Since there are no mechanical devices for the control

of dust in plants in this study (with exception of sandblasting booths), a comparison of dust counts with and without the use of dust control equipment could not be made. For that reason it was decided that dust sampling be made at such a point which would best illustrate dust concentrations of volumes of air that might be inhaled by one or more workers. Samples were taken at:

1. The breathing level approximately one foot from the face of the operator.

2. Approximately one foot from the point of dust origin, either in or out of the path of the dust.

3. A place within the plant considered to be most nearly representative of the general air conditions.

4. A place near the sandblasting booth.

Two to six samples were taken at each plant, according to the number of machine operations and amount of work being done at the time of the visit. Data on lighting and ventilation were recorded before leaving, and a rough diagram of the plant as illustrated Fig. No. 1 was made. The samples were counted always within a period of twenty-four hours and usually within a period of six hours from the time of collection.

Two cells for each sample, each containing exactly one cubic centimeter of the suspension, were made and allowed to settle for at least forty minutes. Dust cells were counted at the same time under the same conditions using a light field and 100 X magnification. Calculations were made and results were recorded on a data sheet as illustrated on the following page.

ENGINEERING SURVEY DATA

Firm Name_____Location_____Date_____
Owner_____Manager_____Dept. Surveyed_____
No of employees_____Size & type of machinery & equipment_____

Dust Sample Data

Sample No	Location	No. Ft.	Vol. Col.	Operation	Remarks

Lighting Data

Outside conditions

Inside conditions

Ventilation Data

Outside conditions

Inside conditions

LABORATORY FINDINGS

Dust Samples

Sample No	Date	When Set Up Time	Set Up Hours	When Counted Time	Counted Hours	Field Count 1	2	3	4	Total	Factor	Particles Per Cu Ft

General Remarks and Conclusions

Dust Counts--Results

Number of Plants Surveyed.....14

Total Number of Dust Determinations 70

Of the fourteen plants surveyed, only seven were equipped with enclosed sandblast booths having an exhaust fan. The other seven were of the type as illustrated (See Fig. No.6) Dust determinations were made in five of the seven modernly equipped sandblast booths and three of the unequipped booths. The following table represents a comparison of conditions with and without the use of control equipment at the sandblasting operation.

	Number Plants Sampled	Dust determinations as dust particles per cubic foot of air		
		Low	High	Average
Where dust control equipment used	5	4 871 500	115 625 000	45 748 333
No dust control equipment used	3	17 625 000	223 900 000	154 437 000

Although the average of counts made where dust control equipment was used is relatively high in regard to certain standards for degree of dustiness it is a considerably smaller figure than that which represents the average dust count at places where there are no control devices used.

Dust Counts--Discussion

Before a critical analysis of the tables is made, it is necessary to bring one's attention to the conditions under which sampling was made, in order that the variations in counts will be explainable. The open type of plant is in itself explanatory of such wide variations in dust counting. Only one of the fourteen plants was found to be of the closed type. Dust determinations in this plant were fairly consistent, varying from 33,000,000 to 59,000,000 dust particles per cubic foot of air at locations identical to those in other plants. The highest count in the plant was 98,000,000 dust particles per cubic foot of air and this operation was done in the enclosed sandblast booth, only one man being exposed. An open type of plant, similar to the closed one just described, varied from a count of 6,550,000 to 309,000,100 dust particles per cubic foot of air. Such factors as direction of the wind, shifting air currents, relative humidity, time of sampling, size of plant (number of operations at time of sampling), point at which sample was taken, and position of the impinger jar at the point of sampling are responsible for the variation in counts.

Chemical Analysis of Granite Dust

Analyses according to methods described in Public Health Bulletin #217 (3), samples of dust obtained from five different varieties of Texas granite showed the following nominal composition:

Sample # 1

Loss on ignition to 850 degrees C	- -	.06 %
Loss to HCl	- -	5.06 %
Loss to H_2SiF_6 (silicates)	- -	65.66 %
Loss to H_2F_2 (silica)	- -	28.94 %
Residue	- -	.08 %
		100.00 %

Sample # 2

Loss on ignition to 850 degrees C	- -	.12 %
Loss to HCl	- -	6.60 %
Loss to H_2SiF_6 (silicates)	- -	64.98 %
Loss to H_2F_2 (silica)	- -	28.10 %
Residue	- -	.20 %
		100.00 %

Sample # 3

Loss on ignition to 850 degrees C	- -	.10 %
Loss to HCl	- -	5.24 %
Loss to H_2SiF_6 (silicates)	- -	65.76 %
Loss to H_2F_2 (silica)	- -	30.68 %
Residue	- -	.22 %
		100.00 %

Sample # 4

Loss on ignition to 900 degrees C	- -	.12 %
Loss to HCl	- -	4.08 %
Loss to H_2SiF_6 (silicates)	- -	55.56 %
Loss to H_2F_2 (silica)	- -	29.76 %
Residue	- -	.48 %
		100.00 %

Sample # 5

Loss on ignition to 900 degrees C	- -	.20 %
Loss to HCl	- -	3.38 %
Loss to H_2SiF_6 (silicates)	- -	65.38 %
Loss to H_2F_2 (silica)	- -	30.06 %
Residue	- -	.98 %
		100.00 %

[redacted] #1-3 are Texas pink granite; samples Nos. 4-5 are Texas gray granite

Roentgenological Studies

A chest roentgenogram was made of each worker in the various plants, using a portable unit capable of developing 80 KV and 15 MA. The time factor varied from 3/8 - 2 seconds. In some instances the films were developed in the field in the trailer laboratory, whereas in other cases they were brought into the home office for developing and reading. In only a few instances was it possible or deemed advisable to ask for a "retake." Our report does not include films which were not considered to be diagnostic. The average age of the workers x-rayed was 37 years. The results are summarized in Table No.4

Chest Roentgenograms--Results

The results of our roentgenological studies may be summarized as follows Of the 115 workers x-rayed:

1 20 % show positive evidence of pathological changes diagnostic of silicosis without infection

2 5.2 % (exclusive of the 20 % in No 1) show positive evidence of pathological changes diagnostic of silicosis with infection

3. 24.6 % (exclusive of the 25.2 % described in No. 1 and 2) show positive evidence of changes which may be described as "more fibrosis than usual."

4. 50.1 % show no evidence of any changes from the healthy chest.

5. 74.4 % of the workers exposed 0-9 years show no evidence of changes from the healthy chest

6 80 % of the workers exposed 10-14 years show no evidence of changes from the healthy chest.

7 39 % of the workers exposed 15-19 years show no evidence of changes from the healthy chest

8 19 % of the workers exposed 20-29 years show no evidence of changes from the healthy chest

9 20 % of the workers exposed 30-39 years show no evidence of changes from the healthy chest

10 No worker exposed over 40 years failed to show evidence of pathological changes

Discussion

An analysis of the data obtained in the survey reveals the fact that:

1 The dust concentrations are too high in each shed studied

2 25 % of the 115 men x-rayed show definite roentgenological signs of silicosis--either with or without infection

3 Another 25 % show fibrotic changes beyond the normal expected in healthy people of the same ages

While no positive statements can be made as to the cause of this increased fibrosis, it seems reasonable to presume that a large part, at least, is the direct result of exposure to siliceous dusts. If this same group continues in its present occupation without protection and is x-rayed ten years hence, a large percentage will undoubtedly show roentgenological evidence of silicosis

Plant owners, as well as employees, want to know:

1 How much dust can be tolerated without harmful effects?

2 What can they do to correct present conditions which are not satisfactory?

The first question can be answered by quoting from the United States Department of Labor Bulletin No 21 (3):

> "Multiply the percentage of free silica by the total particle dust count. If the result is under 5 million, the condition may be considered permissible. If the result is over 5 million, the

condition may be considered too high. For example, 10 per cent free silica with an average total dust concentration of 30 million particles per cubic foot would give 0.10 times 30 million, which equals 3 million (good practice); 10 per cent with an average total dust concentration of 50 million, would equal 0.3 times 50, or 15 million (unsatisfactory). This formula is not applicable to any dust containing less than 5 per cent free silica."

The second question can be answered only when conditions prevailing in each particular plant are considered.

Workers often ask, "Shall I quit my job and learn a new trade--one less hazardous?" This is recommended too freely. It has been learned, however, that it is not so easy for a laborer of 40 years of age and over to learn a new trade and to get a new job. A much more sensible plan is to remain in the trade for which a worker is trained but to protect himself against further exposures known to be hazardous. This can be accomplished on a cooperative basis by employer and employee. Attempts must be made to control dusts at the origin and where this is not practical or possible, then the worker must be provided with, and must use, an approved type of filter mask. All workers with active tuberculosis must be taken off the job and provided for in some way. Certainly they must not be permitted to be in contact with other workers and especially with those who show roentgenological signs of silicosis. It is known that silicotics are extremely susceptible to the tuberculous infection and a large percentage die of this disease.

General Conclusions

1. The dust concentrations in granite sheds in Texas are too high.

2. A large percentage of the granite workers show roentgenological evidence of silicosis.

3. Workers do not believe that there is a serious need to wear masks.

4. Steps must be taken for the control of dust at the point of origin.

Recommendations

Based upon the medical and engineering findings of this survey, the following recommendations are offered for consideration:

1. That an attempt be made to control the concentrations of dust created, by:

   a. Control of dust at the point of origin, using local exhaust devices

   b. Adequate general natural plant ventilation

   c. Good housekeeping. It is important that dust not be permitted to accumulate on rafters, machines, and floors

   d. Adequate disposal of dust from collecting devices, thereby preventing such dust from re-entering the plant

   e. Segregation of dusty operations

   f. Conducting sandblasting operations in a booth designed for that purpose and equipped with an exhaust fan capable of removing all dust. The operator must work outside the booth and be equipped with both respirator and goggles

2. All workers be not only encouraged but required to use goggles, respirators, helmets, gloves, and other protective devices when needed

3. Pre-employment and periodical medical examinations be made of all workers, such examinations including x-rays of chests

4. Frequent determinations of dust concentrations in the various operations be made

TABLE NO. 1

DEGREE OF EXPOSURE AT EACH LOCATION

Location	Number of Determinations	Number of Plants Sampled	Variation of Counts		Average Counts
			Dust particles per cubic foot air		Dust particles per cubic foot air
			Low	High	Average
Surfacing Machine (large)	11	7	750,000	315,000,000	98,850,000
Surfacing Machine (small)		6	23,125,000	98,279,500	38,605,750
Pneumatic Hand Tool	12	10	5,456,000	308,000,000	68,735,333
Sandblast Booth	11	8	4,871,500	371,780,000	95,152,272
Sandblast (small scale)	2	2	84,375,000	111,360,100	97,867,500
General Atmosphere	26	11	5,429,500	141,250,000	35,855,461
Screening Sand	1	1	88,525,000	88,525,000	88,525,000
Drilling	1	1	50,000,000	50,000,000	50,000,000

TABLE NO.

DUST DETERMINATIONS IN EACH PLANT AT SPECIFIC LOCATIONS

LOCATION	NUMBER OF PLANT	MILLIONS OF DUST PARTICLES PER CUBIC FOOT OF AIR													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Surfacing Machine (large)		171.06						43.14	7.25 132.45	85.9 [illegible]5	140.96 7.80		315.00 .75	214.36	
Surfacing Machine (small)		98.28	32.04		25.90	25.99							27.50		23.13
Pneumatic Hand Tool		8.58		5.46		31.00	91.24	125.22	23.50		69.90	37 [illegible]	9.50 40.00	74.88 308.00	
Sandblast Booth		* 4.87	* 32.73	17.63	*	371.78		87.12 71.76 223.90				[illegible]5 55	*	* 64.66	* 115.63
Sandblast(Small Scale)								111.36		84.38					
General Atmosphere			5.43	6.26	32.50	43.42	21.13	34.25		51.88		35.55 57.55	(1) 9.32	141.25 6.35	21.25
Screening Sand												88.53			
Drilling														50.00	

*Plants having an enclosed sandblast booth equipped with exhaust fan.

(1)Represents fourteen determinations.

TABLE NO. 3

ANALYSIS OF THE DUST DETERMINATIONS

LOCATION	No. of Determinations	DUST PARTICLES PER CUBIC FOOT OF AIR						
		500,000 to 10,000,000	10,000,000 to 20,000,000	20,000,000 to 50,000,000	50,000,000 to 100,000,000	100,000,000 to 200,000,000	200,000,000 and above	
Surfacing Machine (large)	11	3		1	2	3	2	
Surfacing Machine (small)	6			5	1			
Pneumatic Hand Tool	12	3		4	3	1	1	
Sandblast Booth	11	1	1	3	3	1	2	
Sandblast (small scale)	2				1	1		
General Atmosphere	26	12	3	8	2	1		
Screening Sand	1				1			
Drilling	1			1				
Total	70	19	4 (23)	22	13	7	5	
Per Cent	100	32.8		31.4	18.6	10.0	7.1	

NOTE : According to the above data twenty-three (32.8 %) of the seventy determinations yield counts considered to be within the "Safe limit"

TABLE NO. 4

Summary of X-ray diagnoses

Years of Experience	X-ray diagnoses for workers in indicated age groups																				Total				Grand Total	
	19 - 29				30 - 39				40 - 49				50 - 59				Over 60									
	Negative	Borderline	Silicosis	Silicosis plus infection	Negative	Borderline	Silicosis	Silicosis plus infection	Negative	Borderline	Silicosis	Silicosis plus infection	Negative	Borderline	Silicosis	Silicosis plus infection	Negative	Borderline	Silicosis	Silicosis plus infection	Negative	Borderline	Silicosis	Silicosis plus infection	Total number examined	Total lung involvement
0 - 9	22	5			6	3	1		4	1	1										32	9	2		43	
10 -14	5				5	2	1		1								1				12	2	1		15	
15-19	1	1			4	5	1	1	2	2				1							7	9	1	1	18	
20-29					1		3		3	3	6	1			2	1		1			4	4	11	2	21	
30-39									2	1	1		1	3	6	1					3	4	7	1	15	
40 +																			1	11			1	2	3	
Total																					58	28	23	6	115	

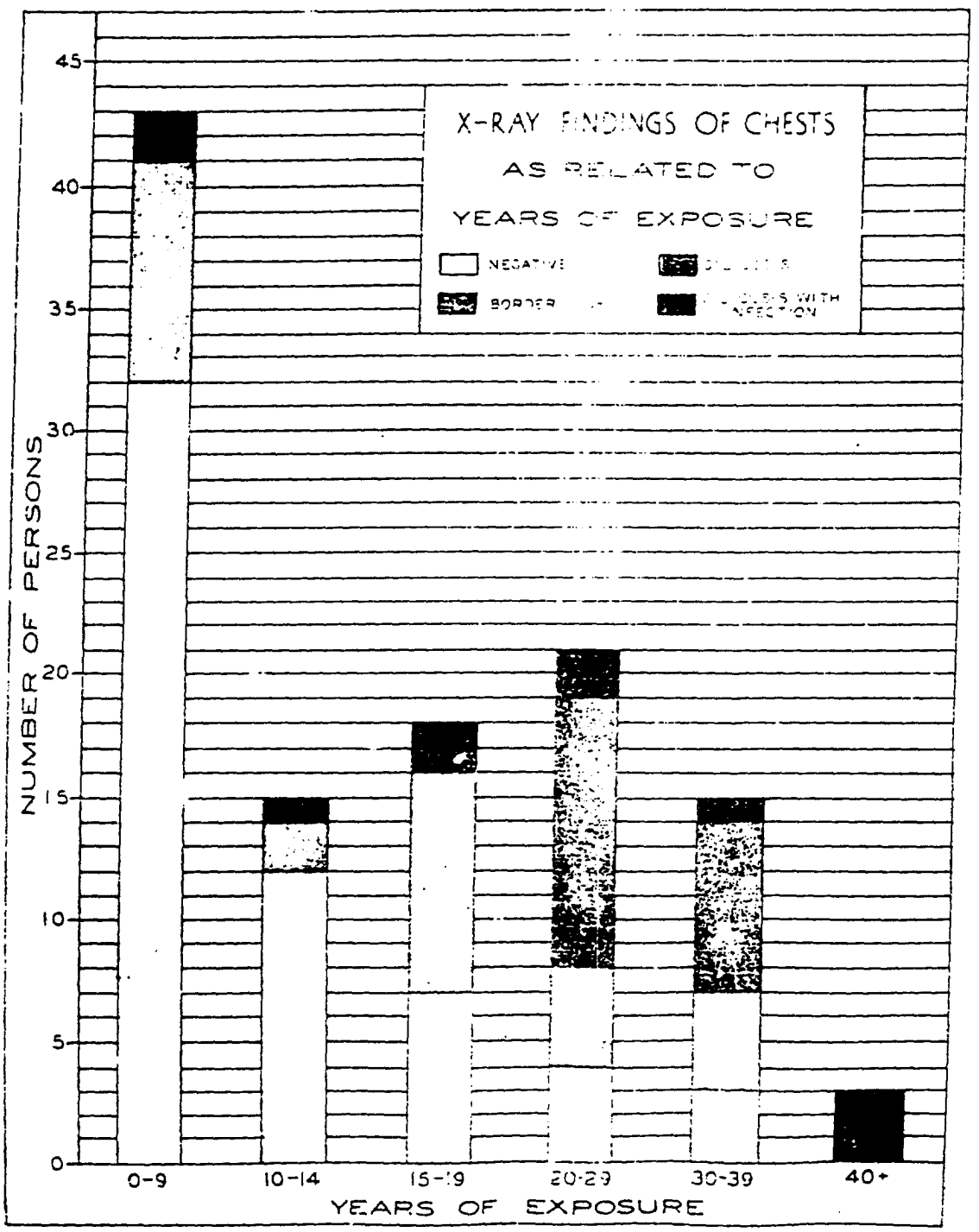
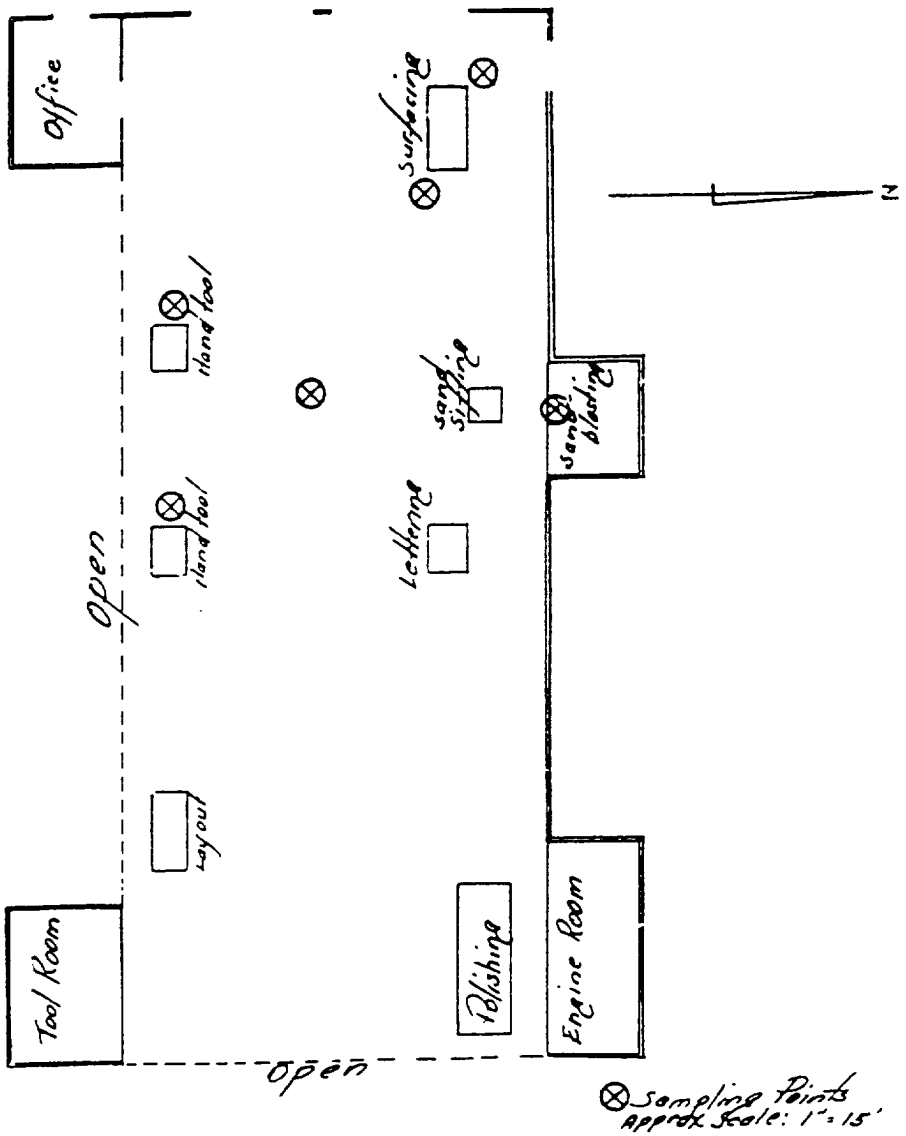

X-RAY FINDINGS OF CHESTS
AS RELATED TO
YEARS OF EXPOSURE
NEGATIVE
BORDER
NUMBER OF PERSONS
0
5
10
15
20
25
30
35
40
45
0-9
10-14
15-19
20-29
30-39
40+
YEARS OF EXPOSURE

TABLE NO 5



LAYOUT OF TYPICAL GRANITE SHED

FIG. NO. 1

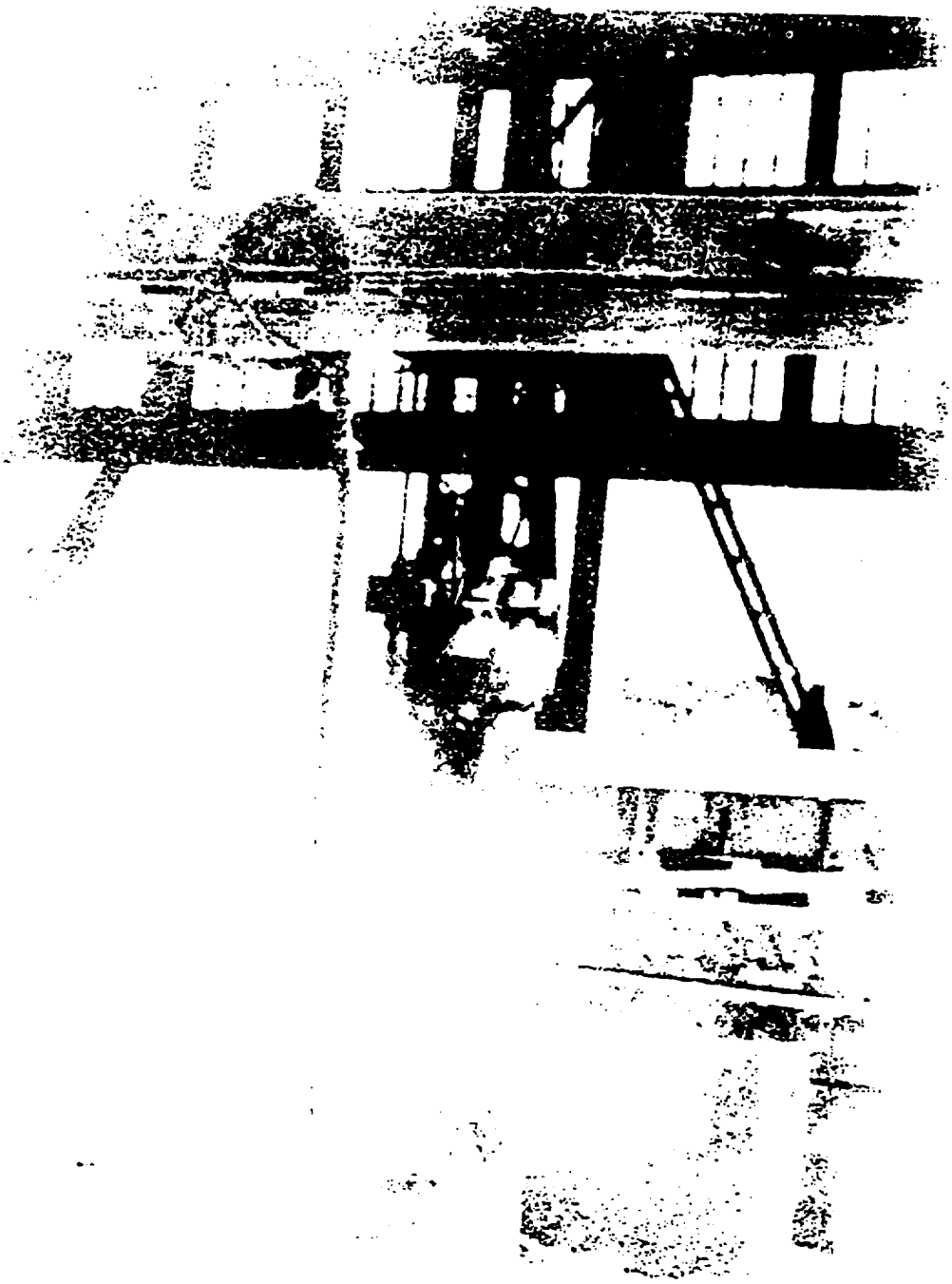


FIG. 3

FIG. 4A

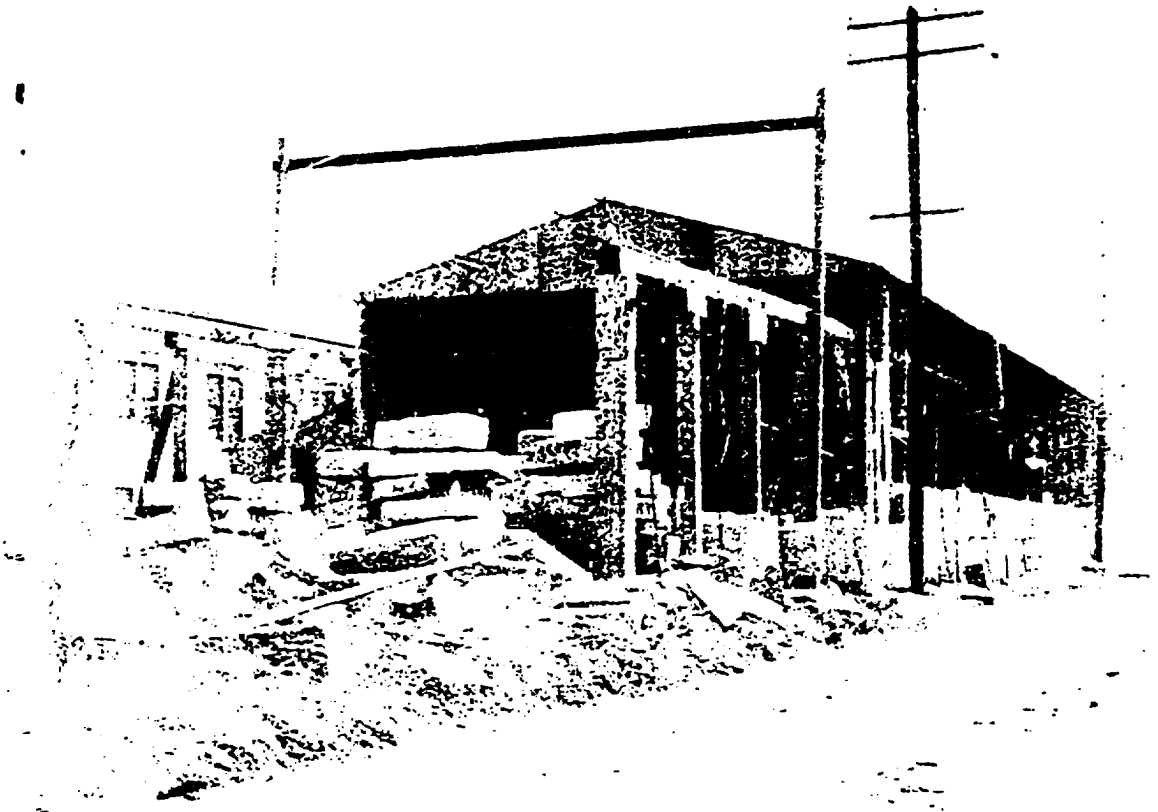


FIG. 4B

FIG. 5

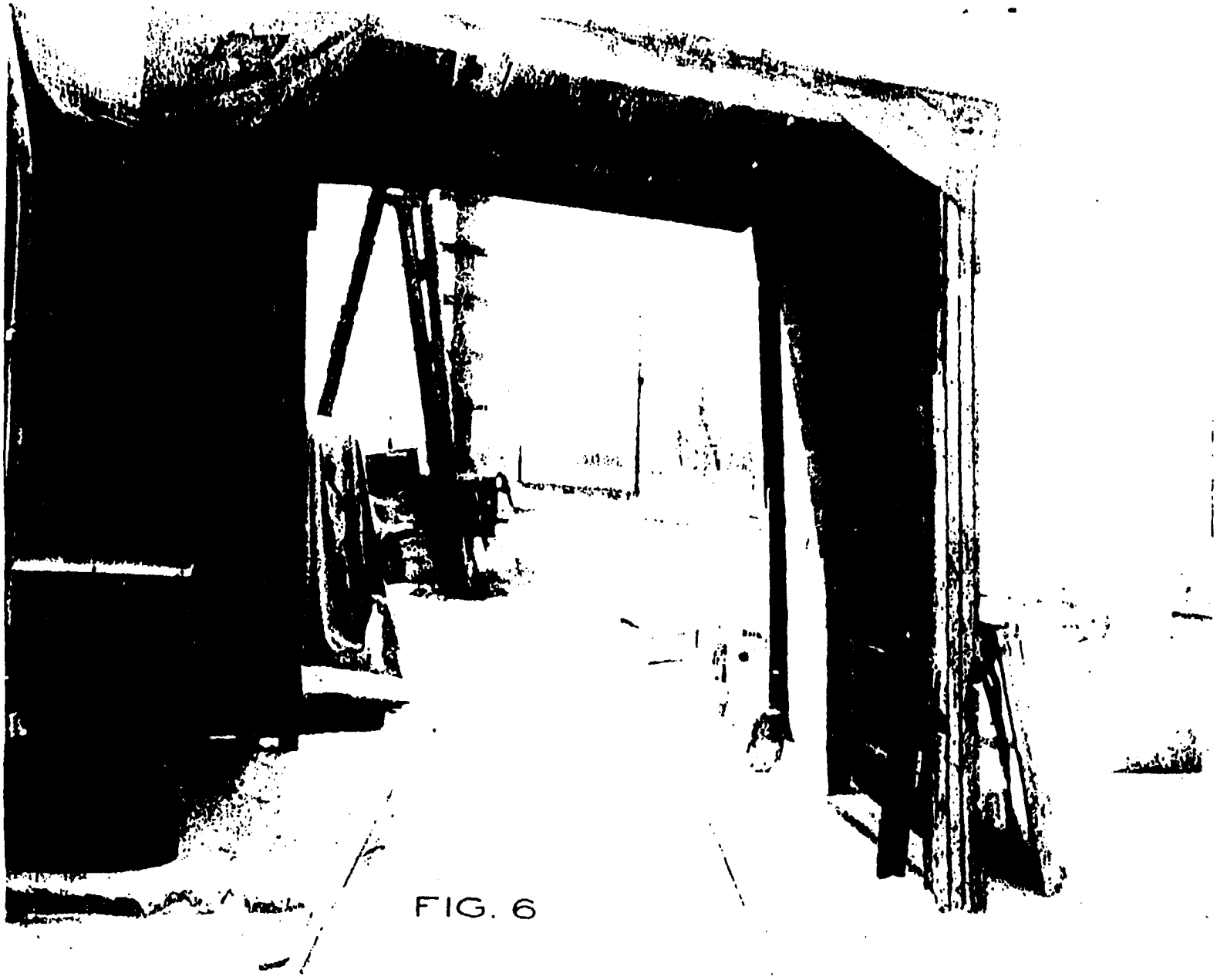


FIG. 6

FIG. NO.7

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