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Occupational Diseases

FRIDAY MORNING SESSION

October 18, 1935

The session was called to order by Mr. W. Dean Keefer, director, Industrial Division, National Safety Council. Dr. C. H. Watson, newly-elected President of The National Safety Council and Medical Director, American Telephone and Telegraph Company, New York City, presided.

Present and Prospective Occupational Disease Legislation

By F. ROBERTSON JONES

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New York, N. Y.

Since the prevention of diseases is, to some degree, a community problem, the state ought to do its part toward the prevention of occupational diseases, along with all others. The public health authorities should study the causes of such diseases, their prevalence, virulence and the means for their prevention. They should advise as to such means of control, and, as a last resort, appeal to legislatures for power to order compliance with their rules. Statutory regulations for prevention, emanating from other sources, such as are common in "labor" or "factory" laws, have too serious drawbacks to be efficient. They are apt to be inflexible and quickly become "out of date"; and they are too apt to be perverted for the establishment of fictitious bases for wasteful and demoralizing damage-suit litigation. Scientific bureaus of occupational hygiene, under direction of public health authorities, are the best public instrumentality. Efficient bureaus of that character are now to be found in several states; but, generally, such public health organizations are inadequately manned and equipped. Therefore the primary need in occupational disease legislation is for measures to improve our public health services.

Emphasis should be placed on prevention, not merely because "an ounce of prevention is worth a pound of cure," but because public measures for the assurance of relief to victims are perilously susceptible of being so perverted that those affected will tend to rely upon and abuse the protection afforded as a substitute for, instead of as a supplement to, means for self-protection.

Expert opinion now calls strongly for the entire elimination of employers' liability for "damages" for occupational injuries—by disease as well as by accident—based upon negligence. That remedy is too uncertain in operation, litigious, demoralizing and wasteful; it furnishes relief to too few of the victims unless it be so liberalized as to be grossly unjust and financially perilous to employers—and thereby harmful to industry and all dependent upon industry.

Losses from ill-health among workmen are primarily subjects for self-providence or for "social insurance"—for "sickness insurance" to help out during brief illnesses, and for "invalidity," "old age" and "widows' and orphans'" insurance where illnesses or infirmities result in long or permanent disability or untimely death. The cost of these insurances against the common misfortunes of life cannot rightly or expediently be imposed wholly upon industry, but needs to be distributed somewhat in proportion to responsibility. And benefits, at a high scale of maximum earnings, as in workmen's compensation, simply cannot be provided for all such workmen's misfortunes. In invalidity, old-age and life insurance, at least, the benefits must be graded, more or less, in proportion to the individual workmen's contributions to the requisite reserves; and the right to benefit must be conditioned upon some minimum number of contributions. It is only for some relatively small proportion of the injuries and physical ills to which workmen are subject that it is reasonable and practicable to impose the full responsibility on industry.

From its beginnings, the workmen's compensation law has covered all injuries to health resulting from occupational accidents. Further it has now, in this country and abroad, been extended to cover many specified diseases, not resulting from accidents, classified as "occupational." And in a few states in this country and Latin America it has been extended indefinitely further to cover "all inclusively" all injuries to health "arising out of and in the course of the employment" or all "occupational diseases," undefined, "arising out of the employment."

In this country there is strong political pressure in favor of this "all inclusive" coverage of injuries by disease based upon the contention that there is no difference in principle between "injuries by accident" and "injuries by disease"; therefore, industry ought to be liable for both classes of injuries on the same terms and conditions. This contention is fallacious. The fundamental principles of the compensation law are that industry shall be held responsible and liable to compensate for the losses from those injuries only which are caused by "trade risks", resulting from employment and which the employer can control; and that the liability for such risks shall be sufficiently well defined as to be insurable at practicable and equitable rates, fixed in advance. The standard compensation laws have been framed to carry out those principles in application to injuries by accident. But the factual conditions relative to injuries by disease are so different from those relative to injuries by accident as to necessitate different treatment.

The crucial difference between accidents and diseases is the time factor. An accident is a sudden event, happening at a definite time and place. Generally the causal relation between the employment and the accident and between the accident and the resulting injury can be traced with reasonable certainty. Generally the employer is automatically identified. And there is a clear-cut event from the date of which time-limits on notices, claims, etc., can be measured. In contrast, many diseases attributable to occupational risks are of slow contraction, and may be of equally slow progress to harmful results. In silicosis there may be an interval of as much as twenty or thirty years between the first exposure and disability or death. In the meantime, many causes for disablement or death, other than the occupational disease may have operated. Often it is a matter of extreme difficulty to determine whether disability or death really has resulted from an occupational disease or from other causes. Medical diagnosis of the mere existence of a particular disease is often uncertain; yet for the proper operation of compensation for occupational diseases it is essential to obtain true medical diagnoses, not merely of the existence of the disease, but also of its causes and consequences.

A further difficulty is that, where the disease is of slow contraction, it may be contracted by a workman under several different employers or insurance carriers. In such cases it is essential for the protection of the workman that some one existent employer or insurance carrier shall be directly liable for the entire compensation. That is a highly vicarious and harsh liability to impose upon an employer or insurer—whether or not accompanied by a right to claim contribution from earlier employers and insurers—and, in all fairness, should be subject to strict limitations.

Moreover there is a difficulty incidental to the provision of new insurance for compensation for such diseases of slow contraction as silicosis. Under such conditions, the liability imposed upon the employer includes a liability for disability or death in the future; in other words, a liability, not merely for future risks but also for the cost of a volume of physical impairments already incurred though the liability therefor is not yet matured. In insurance parlance, these are termed "accrued liabilities." Such accrued liabilities, under a law newly imposing a liability to compensate for silicosis, would, it is estimated, in a state such as New York, aggregate many millions of dollars. This cost is additional to losses from current risks; and how to meet it and how to fix reasonable charges for insuring it is a complex financial problem.

The situation, then, in my opinion, is this: The principle of compensation, regardless of fault, may well be extended to cover those disabling diseases that are characteristic of and peculiar to and have their origin in the occupation or process in which a person is engaged. This would exclude the diseases of ordinary life, and would be applicable only to the specific hazards which arise out of and because of industrial processes and occupations. The provisions for such coverage should be separate and distinct from the provisions of law applicable to compensation for accidental injuries, and these distinctions should be constantly emphasized. The problem of formulating such provisions is relatively simple with reference to those recognized diseases set forth in the older occupational disease laws, since such diseases are reliably diagnosable, of quick contraction and non-progressive. But it is difficult in respect to such progressive diseases of slow contraction as silicosis and asbestosis—now generally regarded as being truly "occupational." Fortunately, however, there are promising models for our guidance in some of the foreign compensation laws, whereas experience under indefinite, "all inclusive" coverage in Connecticut, Massachusetts, Wisconsin and California is helpful with lessons of faults to avoid.

In my opinion, a law for the compensation of occupational diseases should contain provisions to the following effect:

1. Diseases to be made "compensable" should be distinctly specified—by listing in a "schedule" or otherwise. They should include all those diseases, but only those, to be found in the state, which, according to prevailing medical opinion, can be traced, in individual cases, to origins in "trade-risks"—*i. e.*, risks, not of ordinary life, but created by special practices or processes in industrial occupations.

2. There should be a special regime for expert adjudication of medical questions in occupational disease cases.

3. There should be definite periods of exposure required as a condition to the right to compensation for various occupational diseases; the time within which, in order to be compensable, disability or death must follow exposure should be limited; and cases resulting from exposures prior to the effective date of the compensation coverage, or in industries wholly outside the particular state, should be excluded.

4. Prompt notice either of the first manifestation of the disease or of disablement—the time of such event to be determined as a medical question—should be strictly required; and every presumption should be against the validity of a claim not made as promptly as practicable.

5. In case an occupational disease merely aggravates, prolongs or accelerates disability or death due primarily or proximately to a non-occupational disease or infirmity or, above all, to old age, the compensation should be reduced to be proportionate to the degree to which the occupational disease contributes to the disability or accelerates death.

6. The employer, as of the time of the workman's last substantial exposure to hazards of the disease, and the insurance carrier then on the risk should be liable for the entire compensation—with or without right to contribution from earlier employers and insurers. But all such liabilities, whether directly for compensation or for contribution to the compensation payable by others, should be subject to brief time limitations.

7. In incurable diseases, especially silicosis, the obligatory medical benefits should be specially limited in time and kind.

8. In silicosis and other diseases of slow contraction, there should be special provisions for limited compensation to workmen laid off before actual disablement, with the alternative, under some conditions, of waiver of compensation by such workmen for aggravations resulting from being allowed to continue in the hazardous occupation.

9. A law newly imposing liability to compensate for silicosis and other diseases of slow contraction should leave a substantial interval for preparation between the date of its enactment and that when it shall take effect; the compensation for such diseases should be specially reduced and limited below what would otherwise be appropriate until the "accrued liabilities" are worked off.

10. Compensation for occupational diseases should be insurable separately from compensation for accidents; and, in the initial stage, at least, of a regime of compensation for such diseases as silicosis, the rating practices now imposed upon insurance carriers need to be radically modified.

The above program is sound and would be highly conducive to occupational ·ase prevention. But I am not so confident that it would be safe. The pressure is ·ng for "liberality" in compensation laws. Merely a few among a large number ·robable slight diversions from what I suggest would convert compensation for ·pational diseases into indefinite health, old-age and life insurance for workmen in ·y industries. The cost might ruin the industries, and, at least, would be so ·lculable as to make the risks "uninsurable," except on the unlimited assessment ·n, with all its financial perils and uncertainties.

In regard to prevention, there are still some practices to be decided upon in ·ecting a regime of compensation for occupational diseases about which there ·ains much doubt. For example: Such a regime will practically compel employers, ·iving employment, to discriminate against all the ailing or aging—against all ·pt the most healthy and robust. That seems to be desirable in occupations when ·occupational disease hazards are great. But is it desirable otherwise?

Again, an ideal common to those of us who emphasize prevention is to require prompt removal from exposure of workmen manifesting the first symptoms of an ·pational disease. But for the elderly or skilled workman the loss of his trade-job · be worse, in every respect, than the danger of continuing his exposure. How ·, should such cases be defined and treated and how should the law be framed to ·t or induce such treatment?

Political impatience is the chief obstacle to a just and equitable settlement of the ·pational disease problem. If those thoroughly informed as to this complex sub- ·who have sincerely at heart the welfare of workers could be delegated the au- ·ity to devise a solution, some progress might be made. But when political ·aganda is injected into the situation there is little chance for an adjustment ·factory to all concerned. The greatest need today is the divorcement of occupa- ·l disease legislation from politics or political considerations.

Some Practical Considerations in Dust Control

By J. J. BLOOMFIELD

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The prevention of occupational diseases due to the inhalation of industrial dust ·imarily an engineering problem. Until recently, however, little attention had · devoted to the control of dust, accounting for the paucity of fundamental data ·e subject. The consequences of the neglect to furnish adequate protection from hazards are now being felt, and the cost is becoming a serious drain on industry. ·now well established that exposure to certain kinds of dust, such as those con- ·ng considerable amounts of quartz, has increased the morbidity and mortality from respiratory diseases; while metallic dusts, such as lead and its compounds, been associated with general systemic poisoning of workers. It is obvious, ·fore, that any serious attempt to control the dust hazard should, in time, result ·nly in the improvement of the health of workers, but also be of definite economic ·t to industry.

The benefits of a preventive program in the field of accidents are well known. ·try is fast realizing the need of a similar preventive program with respect to ·ational diseases.

Evaluation of the Dust Hazard

The first step in the evaluation of the dust hazard is the determination of the ·ational exposure to the dust in question. A typical example of such a study serve to clarify the methodology involved.

Table 1 shows the various occupations in a granite quarry and the number of ·ers employed in each occupation. Drillers are the only persons using pneu- ·tools, known to produce considerable quantities of dust. In other words, 38 ·ent of the quarry personnel are shown to be exposed to a potentially dangerous ·hazard. The occupational analysis at once indicates that the dust investigation should especially concern itself with these workers. The next step involves the determination of the occupational dust exposure. Table 2 shows the results of such a study.

Table 1—Occupational Classification of Granite Quarriers

Occupation	Number in Each Occupation
Drillers:	
Leyner	17
Plug and jack hammer	37
Other quarry employees:	
Superintendent	1
Foremen	7
Compressor engineer	1
Hoisting engineers	12
Locomotive engineer	1
Locomotive fireman	1
Steam-shovel man	1
Crane operator	1
Derrick men	24
Muckers	24
Blacksmiths	6
Tool boys	2
Water boys	1
Machinists	3
Air-line repairers	1
Pipe fitters	2
Total	142

Table 2—Occupational Dust Exposure of Granite Quarriers

Occupation	Number in each occupation	Dust counts in millions of particles per cubic foot of air. Weighted Average
Leyner drillers	17	144.4
Plug and jack-hammer drillers (quarry-hole)	37	112.1
Plug drillers (yard)		36.9
All other workers	88	5.8

It is apparent in this table that the drillers are exposed to high dust concentrations, especially the Leyner and jackhammer drillers working in the quarry hole. From a further analysis of the occupational dust exposure of drillers it is possible to determine which activities are responsible for the dust. For example, experience has taught us that the various activities comprising the processes of most dusty occupations are usually associated with dissimilar dust exposures. For this reason it is essential to estimate the amount of time spent in each activity in any one occupation and to determine the dust exposure for each. Table 3 shows the results of such a study in the case of a Leyner driller.

It will be seen that a Leyner driller has five different dust exposures. A differential analysis, as presented in Table 3, yields several valuable findings. First, it enables one to obtain a true average dust exposure for workers engaged in the occupation of Leyner drilling. (In this case the weighted average is 144.4 as contrasted with 213.4 million particles per cubic foot found during drilling operations only.) Second, it enables one to determine which activity, or activities, contribute most to the

Table 3—Summary of Dust Exposure of Leyner Drillers in a Granite Quarry

Activity	Average dust exposure in millions of particles per cubic foot of air (a)	Number of hours spent in each activity (b)	Particle-hours in millions per cubic foot (a × b)
lling	213.4	4	853.6
nging drills	9.8	1	9.8
tching drills	8.0	2	16.0
aching	6.0	¾	4.5
wing off holes..............	1,085.0	¼	271.3
Total..............................		8	1,155.2

$$\frac{55.2 \text{ particle hours in millions per cubic foot}}{8 \text{ hours}} = 144.4 \text{ million particles per cubic foot}$$

l hazard. It is evident that the practice of blowing off holes by means of inserting mpressed air line into each hole is attended with a great amount of dust; and ugh this activity lasts but 15 minutes of the 8-hour working day, it is responsible 23 per cent of the total dust exposure. It is evident that 23 per cent of the Leyner ller's dust exposure may be at once eliminated by prohibiting this practice. And lly, such an analysis indicates the necessity for devoting all one's efforts to the noval of dust during the drilling process, since this activity accounts for 74 per cent the total dust exposure, although a Leyner driller spends but one-half of the king day at his drill.

So far we have dealt with an industry in which the workers, as a rule, do not nge their occupation. Often workers have had several occupations, either in the ne industry or in several different kinds of establishments. If the worker has been ployed in various occupations in the industry, it is a simple matter to determine total dust exposure in that industry. This is important from the viewpoint of relating a worker's dust exposure and his clinical condition. A typical example is wn in Table 4.

Table 4—Total Occupational Dust Exposure of an Anthracite Coal Worker

Occupation	Number of years in each occupation	Dust concentration in millions of particles per cubic foot	Millions of particle-years per cubic foot
te picker	2	380	700
lher	2	71	142
le driver	3	71	213
r's laborer	3	480	1,410
ner	15	480	7,200
tion foreman	5	7	35
Total................................	30		9,790

$$\frac{\text{90 millions of particle-years per cubic foot}}{\text{30 years}} = 326 \text{ millions of particles per cubic foot}$$

In Table 4 the worker's occupations are arranged in the order of employment, last one being his present occupation. It is obvious that had one considered this upation only, the dust exposure would not have yielded a true state of affairs,

nor would it have been possible to correlate this dust exposure with the man's clinical picture. In the above technic, correct weight is given to the number of years spent in each occupation and the dust exposure associated with each. Only by such an analysis is it possible to arrive at a fair estimate of a worker's dust exposure and his proper designation. Such an analysis is justified by the fact that results obtained with this technic yield excellent correlations with the clinico-roentgenological studies conducted on anthracite coal miners.[2]

It is thus apparent that there is more to engineering dust surveys than the taking of dust samples and their analysis. Owing to the fact that the making of dust studies is rapidly being adopted in industry, it has seemed necessary to emphasize the important factors in such investigations. Although the making of dust counts, *per se*, is not a difficult procedure, the collection of dust samples in industry and their proper interpretation should be done by a thoroughly trained investigator. The examples just given show the value of this technic in the subsequent steps to be taken in the control of the industrial dust hazard.

Dust studies
air sampling

General Dust Control Methods

The selection of any method of dust suppression will depend primarily upon its effectiveness in reducing a given hazard and its adaptability. A large percentage of reduction in dust does not necessarily indicate that the method used is efficient, unless the reduction has actually been sufficient to bring the exposure below the safe limit, and does not interfere with the industrial operations involved. In general, there are four methods of dust control: (1) substitution of nondust-producing or harmless substances; (2) isolation of the dusty operation; (3) wetting the dust at its source; (4) local exhaust ventilation. These methods may be supplemented by personal respiratory protection.

dust control

The first method has a limited application. One example is the use of a nonsilica parting compound for a silica compound in connection with the making of foundry molds. Table 5 shows that although the use of parting compound, in this particular study, only necessitated an exposure of 54 minutes of the 540 minutes of a molder's work day (10 per cent), actually this activity accounted for approximately 58 per cent of the molder's total exposure. It is obvious that the employment of a parting compound, which is not as harmful as one composed of free silica, will lessen the dust hazard in this instance to a considerable extent.

Table 5—Dust Exposure of Molders

Activity	Time of Exposure in minutes (a)	Average Dust Exposure in Millions of Particles per Cubic Foot (b)	Particle-Minutes in Millions (a × b)
Use of Parting Compound........	54	63.8	3,445
Remaining tasks in molding.......	412	4.4	1,813
Pouring	58	3.1	180
Dumping molds ("shake-out")....	16	32.5	520
Total....................................	540	....	5,958

$$\frac{5958 \text{ million particle-minutes}}{540 \text{ minutes}} = 11.0 \text{ million particles (per cu. ft.)}$$

In the case of abrasive cleaning with steel instead of sand, we have the example of the substitution of a substance involving a lesser dust exposure as well as the use of a material not as toxic as sand.[3] Table 6 shows the improvement effected by this type of substitution. Not only is the dust concentration reduced from an average of 969 to 155 million particles per cubic foot, but the potential exposure to quartz dust is diminished from 42-99 to 3 per cent.

substitution

ble 6—Showing Reduction in Concentration and Quartz Content of Dust in Sandblast Rooms With the Substitution of Steel for Sand Abrasive

.e of rasive	Average dust concentration in millions of particles per cubic foot	Percentage of Quartz
d	969	42-98
l	155	3

The second method of dust control, isolating the dusty process, possesses many ibilities, but unfortunately is not widely used. The theory underlying isolation concentrate the dust sources to one locality or to a single closed space. In this . a minimum number of employees are exposed. At present, many foundries, dur- shake-out expose workers who normally are engaged in occupations with low concentrations. Thus, molders in a foundry may be exposed to a dust concen- ion of 3 million particles per cubic foot under normal occupational conditions, but n shake-out operations are carried on close by, their exposure may be increased more than 50 million. The same condition exists when annealing flasks containing and slag are emptied in malleable iron foundries, exposing grinders and tumbling el attendants at work close by.

Perhaps the best example of isolation of a dusty process is the abrasive cleaning n. This completely encloses a hazardous process and exposes only the blaster who enerally equipped with a protective helmet. The room is also exhausted, which her reduces the dust concentration. Processes which are isolated require good ilation. Other examples of isolation are the automatic turntable for abrasive ning, tumbling barrels, and batch-mixing rooms found in some pottery establish- ts.

The third method, perhaps the oldest known, is the practice of wetting the dust s source. In Table 7 an example is depicted in connection with the drilling and ing of rock in anthracite coal mine operations.[3] It is apparent that a tremendous ction in dust has been effected by this method. However, as already pointed out, ss a particular method is attendant with a reduction of the dust to a safe limit, nnot be considered successful. In the present instance, the workers engaged in ing are still exposed to unsafe concentrations of a highly dangerous dust and more positive method of controlling the dust in drilling operations by dust traps d be indicated. For drilling and loading operations involving an exposure to dusts toxic as those containing high amounts of free silica, as in the case of coal or in talc, the reduction shown by the use of wet methods may be considered tive.

le 7—Contrasting "Wet" and "Dry" Methods of Rock Drilling and Loading

esses	No. of Samples	Average dust count in millions of particles per cubic foot "Dry"	"Wet"
ing	23	568	33
ing	10	636	32

The fourth method—exhaust ventilation—is perhaps the most effective, and one the widest application. We cannot discuss here the details of the theory and n of local exhaust systems, except to point out there is a real need for more imental studies of the type conducted by DallaValle with reference to the design cal exhaust hoods, which he has presented in Public Health Bulletin 217. The of Hatch and his colleagues[4] on the control of the silicosis hazard in the hard industries is another example of a scientific approach to the dust elimination em.

Table 8—Summary of Results Contrasting the Dust Exposure of Mine Workers Under Controlled and Uncontrolled Working Conditions

Operation	Dust Concentration in millions of particles per cubic foot of air Controlled	Uncontrolled	Remarks
Firing charge	40	834	Unless at least 15 minutes elapsed after firing a charge, miners found to be exposed to high dust concentrations.
Loading coal or rock..	32	636	By wetting the loaded material the dust count is reduced as shown.
Loading coal	4-26	291-1138*	Mechanical loading decreases the dust exposure as indicated.
Drilling	33	568	Wet drilling is effective in reducing the dust concentration. Further reduction would necessitate exhaust ventilation.
Hauling coal in mines.	1.2	17	Wetting coal and empty cars reduces dust in haulageways.
Preparation of coal...	24	380	Wet breakers reduce dust counts as shown.

*The lower result is associated with the hand loading of wet coal while the higher average is based on the hand loading of dry coal.

It is apparent that there are no set rules for the mechanical protection of workers from the industrial dust hazard. Specific conditions in an industry, or a plant, will determine the type of protection to be employed. The present discussion has emphasized the importance of approaching the problem from the standpoint of the occupational exposure. Studies in representative plants of an industry often reveal the various methods which may be employed in controlling the dust hazard. The following two examples indicate the value of such investigations.

Table 8 indicates the various control measures which were found in use in the anthracite coal mines investigated in the study referred to earlier. Although no single mine practiced all of the control measures shown in this table, by an occupational study in several representative mines it was possible to show that methods are not known and practiced for the elimination of the dust hazard in this industry.

Another example is indicated in the results of a study now in progress in connection with mercurialism among workers in the hatters' fur cutting industry. Table 9 shows the exposure to mercury dust and vapor of some of the workers in this industry

Table 9—Exposure of Hatters' Fur Workers to Mercury Dust and Vapor Under Controlled and Uncontrolled Conditions

Occupation	Total Mercury Exposure in Milligrams per 10 cubic meters Uncontrolled	Controlled	Method of Control
Blowers	4.6	..	None practiced
Shippers	7.2	..	" "
Cutters	4.0	1.8	Local exhaust ventilation
Sorters	3.8	1.7	"
Brushers	3.1	1.2	"
Drummers	2.5	0.6	Segregation
Clippers	1.5	0.7	"

under controlled and uncontrolled working conditions. It is apparent that where some measure of control is practiced by such methods as segregation or local exhaust ventilation, a material reduction in the exposure to mercury has been effected. It is our belief that in the case of the blowers' exposure, a reduction may be effected by mechanical enclosure and local exhaust ventilation, and that the shippers' exposure to mercury vapor may be lessened by a general system of ventilation sufficient to change the air in the store room frequently enough to bring the mercury concentration to a lower level. Unfortunately, in the present investigation, it has been impossible to find a plant in which an attempt has been made to reduce the exposure for these two occupations.

In some dusty occupations the methods of controlling dust have not been developed. In fact, operations such as removing the cores from very large foundry castings, sand-blasting, handling of used storage battery plates, paint chipping, and cadmium oxide manufacture appear to offer no practical means of adequately controlling the dust generated. In such cases, it is therefore necessary to furnish the worker with personal respiratory protection devices to prevent his exposure to the harmful effects of the dusts present. These devices consist of various types of respirators, masks, and helmets.

It is important to hold in mind the limited use of personal protection devices. Because a worker cannot with comfort wear a mask or helmet continuously, such devices must be employed intermittently. Their use is generally extended to those operations where all other methods have failed or supplementary to them, as in storage battery repair where the exposure to small amounts of lead breathed is known to be detrimental to health.

It should be pointed out that the U. S. Bureau of Mines is equipped to conduct approval tests of respirators used for protection against various dusts and fumes (Schedule 21). These tests are conducted against the dust for which the device is to be used and are rated, not on an efficiency basis, but on the quantity of dust which actually passes the respirator. The results of a study of masks or helmets of the positive pressure type, made during the sandblast investigation conducted several years ago by the Public Health Service in cooperation with the National Safety Council, showed that the only practical safeguard to the worker inside the sandblast room was to provide him with a mask or helmet of the positive pressure type. In studying the efficiency of such devices it was found that a relationship existed between the amount of air supplied to the helmet and the concentration of dust inside the helmet during blasting. To determine the optimum air volume to be supplied to such protective devices, it was necessary to obtain dust samples from inside the helmet while varying the air volume, at the same time maintaining the dust concentration in the sandblast room (outside the helmet) constant. The positive supply of 6 cu. ft. of dust-free air per minute will protect a worker under the operating conditions now in practice in sand-blast rooms. The ultimate criterion of protection, however, is the result of dust determinations of the air within the helmet, that is, the air actually breathed by the worker and not the volume of air supplied.

Too much emphasis cannot be stressed on the necessity of maintaining in good order the personal respiratory devices for the protection of the worker against various toxic dusts. Maintenance of exhaust ventilation systems, and other types of protective equipment, should be a rule in industry rather than an exception. Too often the term "good housekeeping" has been interpreted as signifying only the periodic removal of dust collected on floors, rafters, etc. Although such practice contributes to the general state of cleanliness of a workroom and should always be in force, the time has surely come when serious attention should be given to the installation and rigid maintenance of all types of dust control devices. In every plant there should be some responsible individual charged with the periodic inspection of all workrooms as to sanitation, ventilation, and maintenance of all dust removal and other protective devices. Perhaps the best criterion of the effectiveness of these devices is the periodic determination of the dust content of the air at the workers' breathing zone. Only by constant vigilance and an approach to the problem as outlined in this paper can we hope to make progress in the control of the dust hazard in industry.

Often the benefits of even a most extensive program of dust control are not immediately realized. This is especially true in dealing with fibrosis-producing dusts in plants where some of the workmen have already inhaled sufficient quantities to cause disability. However, in dealing with such dusts as lead, cadmium, and mercury compounds, control measures may produce salubrious results in a relatively brief period. It is difficult, because of lack of sufficient reliable data, to indicate here the economic benefits resulting from a preventive program of dust control. It has been estimated by Dean K. Brundage, statistician of this office, that the minimum expectancy in savings to employer and employee from an indicated reduction of the accident rate and of the time lost on account of illness (or an equivalent reduction in mortality), demonstrated as attainable, is $20,000 per year per 1,000 employees. And this estimate is for plants whose accident rate is considerably below the average, in which there are no occupational health hazards. In plants where hazards are known to exist the savings should be far in excess of this conservative estimate. When one realizes that in this country there are approximately 15 millions of workers engaged in manufacturing, mechanical, and mineral industries, then it is evident that the magnitude of the problem has not been overemphasized.

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Silicosis and Silico-Tuberculosis
Medical Problems of an Important Industrial Disease

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A hidden element of the cost of production is industrial disease. Industry has reached a stage beyond the concern only of wages and hours. Far more important is conservation of man power by preventive medicine and improved engineering. Disease preventive measures are not a cost, but, in the long run, a great economic saving.

Incidence. In the United States it has been computed that there are from 500,000 to a 1,000,000 people employed in occupations where a silicosis hazard exists. In New York City there are about 65,000 such employees. In a representative group of granite workers in Massachusetts silicosis alone was present in about 15 per cent and silicosis complicated with tuberculosis in almost 8 per cent. Tuberculosis was the cause of death in over one-third of the granite workers which is four times the incidence for males of 20 years and over in this country. In foundry men studied in Massachusetts, silicosis was less frequent (about 9 per cent) and less advanced in degree than in granite workers. The duration of exposure in foundry workers with pneumonoconiosis has averaged many more years than that required to produce silicosis in an industry such as gold mining. The tuberculosis hazard in foundries is nearly as great as that reported for some of the other dusty trades, but the figures are much lower than those of miners of gold, silver, copper and lead, among whom the mortality from tuberculosis is 8 to 18 times the general expectancy. Death rates for all non-tuberculous infections have been reported higher among workers in siliceous dusts than in the general population. It is suggested that the worker in silica succumbs more often to acute pulmonary infections rather than surviving the chronic fibrosis.