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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

General Manager, Association of Casualty and Surety Executives

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 They are apt to be inflexible and quickly become "out of date"; and they are too apt to be perverted for the establishment of fictitious bases for wasteful and demoralizing damage-suit litigation.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 ease prevention. But I am not so confident that it would be safe. The pressure is ing for "liberality" in compensation laws. Merely a few among a large number robable slight diversions from what I suggest would convert compensation for upational 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 alculable 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 fecting a regime of compensation for occupational diseases about which there ains much doubt. For example: Such a regime will practically compel employers, giving 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 upational 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 upational 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

anitary Engineer, United States Public Health Service, Washington, D. C.

The prevention of occupational diseases due to the inhalation of industrial dust rimarily an engineering problem. Until recently, however, little attention had devoted to the control of dust, accounting for the paucity of fundamental data he 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 it 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

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

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.

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
anging drills	9.8	1	9.8
tching drills	8.0	2	16.0
aching	6.0	3/4	4.5
wing off holes..............	1,085.0	1/4	271.3
Total....................		8	1,155.2

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

t hazard. It is evident that the practice of blowing off holes by means of inserting ompressed ai. 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 ly, such an analysis indicates the necessity for devoting all one's efforts to the *oval 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 ing 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 e industry or in several different kinds of establishments. If the worker has been *loyed 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 elating 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
aher	2	71	142
le driver	3	71	213
er's laborer	3	480	1,410
ner	15	480	7,200
tion foreman	5	7	35
Total........................	30		9,790

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

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.

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.

The first method has a limited application. One example is the use of a non-silica 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

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

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.

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 t 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 ore than 50 million. The same condition exists when annealing flasks containing nd 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 ng 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 an 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 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.

Silicosis is defined as a pathologic condition of the lungs due to the inhalation ilica, whether free or combined in such a state as to be capable of setting up its :acteristic pathogenic effects. The principal factors that determine the incidence ilicosis are (1) the percentage of free silica in the inhaled dust; (2) the con- ration of silica particles less than 10 micra in diameter in the atmosphere; (3) duration of exposure to the dust, and (4) the susceptibility of the individual osed as modified by age, complicating infections, etc. The occupational disease lting from such inhalation has been defined as "morbid results of occupational vity traceable to specific causes or labor conditions and followed by more or extended incapacity for work."

Metabolism of Silica. Significant amounts of silica are present in all body ies and fluids. It enters the body through the digestive tract and the lungs. t of that entering the stomach is eliminated in the stools, but a fairly large unt is absorbed into the blood as shown by the constant excretion of silica in urine. All vegetable foods contain silicon especially the hulls of grains, hay and w. The low silica content of the liver, spleen and kidneys indicates the little ntion of the absorbed silica in the body. Silica content of the urine of animals be influenced at will by diet. The body possesses a very efficient mechanism the disposal of silica because of the low kidney threshhold. Silica entering lungs in particulate form is expectorated in part with its enveloping cells, but t of it is carried into the pulmonary lymph channels. Many such particles reach lymph nodes and even the spleen by way of the blood. The finest particles ver, may be dissolved in alkaline body fluids and carried away in solution, to xcreted in the urine. There may be a constant drainage of silica from the through the inhalation of extremely fine particles of silica in dusty atmospheres, mall that they are not seen under the microscope.

Attempts to influence the absorption of silica from the lungs by administration lkali have been inconclusive. Elimination of silica by way of the sputum from ents having deposits of silica in their lungs appears to be higher than those ng no history of exposure to dust. Only small amounts of silica are in the d and this level is little different in normals than in silicotics.

Pathology. This disease is essentially a fibrosis of the lungs developing espe- y in such industries as hard-rock metal mining, granite cutting, metal grinding sand-blasting. The pathological changes are believed to result from two causes, ocking of the lung lymphatics by mononuclear cells laden with dust in addition he action of colloidal silica, the exact nature of which is in doubt. The small icles under 10 micra are the only ones capable of penetrating the lung tissue.

Although silica plays the dominant role in the production of silicosis, the ad- ure of other dusts tends to modify the pathological changes in the lungs so these resemble then those of other forms of dust inhalation, and the modification s some relation to the percentage of free silica in the mixture. Silicates, as in stos, produce a definite change in the lung, as well as other dusts such as de, coal, etc. Such changes are represented by a fibrosis brought about because ively insoluble minute particles of minerals in sufficient concentration have brought by the activity of phagocytic cells into intimate contact with the enary connective tissue. This fibrosis is a diffuse cellular one that occurs in walls of the smaller bronchi and of all their finer divisions and extends to ve the supporting connective tissue of the adjacent blood vessels and to some t also the walls of adjacent air spaces. However, when the great majority of nhaled particles are composed of or contain silica, there develops, in addition, a fic and localized type of fibrosis called the silicotic nodule—an orderly whorled gement of cells and fibres, and with sharp definition from the adjacent paren- a. Many dusts create a generalized fibrosis but only one, namely one combined silicon dioxide produces the special fibrosis of silicosis. Sericite, known as mica, which is a hydrated silicate of aluminum and potassium, has not produced imal experiments the silicotic nodule, but instead generalized fibrosis resulted.

Dusts must be differentiated into those which are *chemically active* and those t are inert when inhaled into the respiratory tract. Silica is a chemically active which must necessarily be *soluble* to a degree in the body fluids and its activity ds on its solubility. This activity which is manifested in the areas where dust les are carried along the lymph stream by phagocytes, causes lesions of two

types, "toxic" and "sclerotic" both of which have been reproduced experimentally. Toxic lesions depend upon local necrosis and slow death and appear to favor the growth of tubercle bacilli; the sclerotic lesions produce the nodular fibrosis. The *inert dusts* are insoluble in body fluids and cannot exert chemical action in the lung tissue, but if they accumulate to a marked extent their effect is mechanical which may lead to a certain amount of diffuse fibrosis around the dust deposits. Certain dusts, such as carbon, may have physical effects, they may adsorb toxic substances and it has been suggested that on this basis there is a relatively lower incidence of active clinical tuberculosis in silico-anthracotics than in silicotic lungs.

Other dusts may even protect, as in the case of certain clays, gypsum and aluminum oxide. Pure pneumonoconiosis may be only a laboratory disease, as the pulmonary fibrosis of workers in dusty trades probably results from the combined action of dust and infection, whether it be tuberculous or not.

In silicosis it is not the mineral particles that are breathed in during life that record the cause of disease, but the particles that have been dissolved. Risk to work, efficiency and health may be greatly accentuated through the inhalation of finely divided particles even of a chemically inactive dust when there has occurred a lymph stasis which is known to follow exposure to silica. This lymphatic blockage leads to retention and accumulation of the inert dust. In soft coal miners who get what is called "miner's asthma" we have this accumulation of carbon. Such patients are very liable to have a high incidence of bronchitis with mechanical and physical changes due to retention of anthracotic dust. Furthermore, unequivocal cases of silicosis, with or without tuberculosis, can no longer be doubted.

Tuberculosis. Most apical tuberculosis is acquired before the age of 25 and so silicosis at the age of 30 makes a previous tuberculosis more serious. Most workers with tuberculosis going into the mines before the age of 30 die of tuberculosis by the age of 45. The silicotic develops a sputum that contains tubercle bacilli late in life and the children who are contacts with tubercular silicotics develop very little clinical tuberculosis. It is impossible to say definitely that tuberculosis engrafts itself upon the silicotic or vice versa, for we see apical tuberculosis in silicosis that spreads downward, while other silicotics show only the tuberculosis in the lower lobes. It has been found that most silicotics die of tuberculosis.

The diagnosis of silicosis is made primarily on two findings, the proper history of occupational exposure to siliceous dust and the presence of abnormal shadows on the pulmonary X-ray. The physical examination and the patient's symptoms are of less value. There are other diagnostic aids such as the finding of large quantities of silica particles in the sputum, quantitative determinations of silica in urine, and at post mortem, chemical analyses of the lung ash supplemented by petrographic examination, roentgen-ray spectrum analysis and special incinerating studies of lung tissue. We must at times rely on the pathologist to determine the amount and distribution of fibrosis due to silica and from microscopic studies give an opinion on the importance of this fibrosis as the ultimate cause of disease and death.

Lung fibrosis may be present without any silica. Silica may be present in lung tissue or the pulmonary lymph channels without associated fibrosis. Finely divided siliceous particles from lung tissue may contain innocuous silicate which cannot be distinguished from harmful silica particles. Hydrated silica which is not doubly refractive cannot be demonstrated with prisms. Therefore in the pathological section the presence of siliceous fibrosis can be suspected but cannot be specifically identified with the siliceous material that it may contain. Accordingly the microincineration method of Irwin with hydrochloric acid is now included in the microscopic examination of any lung as a means toward a surer diagnosis.

Diagnostic difficulties in clinical medicine may be more obvious if we examine first the occupational history. Quartz grinders working under conditions of massive exposure may develop silicosis in acute form even in a period of months, whereas in other occupations it may take 25 years. Workers in the same industry, indeed in the same room, experience different degrees of exposure dependent upon perhaps the dust-filtering capacity of the nose and functional condition of the lung as deter- mined by constitutional characteristics and antecedent disease. The size and col- loidal structure of the particles of silica, as well as the dosage and total amount of silica, will influence the rate of development of the disease. Apparently particles that are larger than 10 micra are not phagocytosed in the lung. So a definite ory of exposure must be established and in general hospitals where patients are ratory, conditions under which they worked are very vaguely described and re are not available data on dust counts and silica concentration, so that the history ften misleading.

As to symptoms, patients can perform strenuous labor despite extensive disease l the symptoms of dyspnea and cough are common to many diseases. Fever is nt unless infection occurs, but most important is the great disproportion between atient's complaints and what is seen on the X-ray, the latter showing extensive ormal shadows in comparison with the symptoms.

On physical examination, extensive disease may be present and few abnormal sical signs. The physical signs are merely those of a general pulmonary fibrosis h emphysema, such as restriction of costal and diaphragmatic movement, diminu- of or intensified breath sounds and a hyperresonant note. Rales are usually nt unless infection is present.

As to the *X-ray*, there are 3 essential types of shadows described, linear strands, ll discrete shadows, and homogeneous shadows of varying sizes; these corre- nd to the fibrous strands, silicotic nodules, and the conglomerate masses fibrosis. The nodular shadows are usually characteristically around the m, or conglomerate nodular shadows of bat-wing appearance extend into both r lung fields, or nodular shadows may be distributed in the upper two-thirds he lung fields, perhaps more pronounced on the right side, with the lower third clear by emphysema. With infection present, the shadows are less sharp or linear strands interconnect or fuse. Large conglomerate shadows appearing from the hilum leaving the periphery of the lung clear throughout because of hysema. The distribution of some of these lesions may be determined by the ure assumed by the workers, and infection may likewise determine an ultimate ical distribution. Many variations from these patterns are seen in the X-ray, cially under excessive exposure or when other dusts are inhaled, or in the ence of infection. It is probable that the main source of the diagnostic diffi- es is caused by the emphysema which muffles the physical signs and is respon- emphysema, such as restriction of costal and diaphragmatic movement, diminu- in great part for the absence of symptoms. It may blot out, even on X-ray, ilicotic lesions of fine size. Examples of such difficulties in diagnosis as encoun- d by us are the following:

Case I—Mr. T. A forty-five year old man entered the New York hospital plaining of mild cough and expectoration of four months' duration. He appeared ly ill, his fever was 103 degrees and respiration 28. Rales were elicited over upper half of both sides of the chest. Examination of his eye grounds revealed eral retinal tubercles: his sputum contained numerous acid-fast organisms. X-ray revealed fine mottled shadows distributed throughout both lung fields a small cavity at the left apex. A diagnosis of miliary tuberculosis was made. ever, after one weeks' stay in the hospital, his temperature and pulse returned ormal and during the following month he gained 18 pounds. The signs in his now became confined to the left apex. In view of his unusual progress the nosis of miliary tuberculosis was doubted. His occupational history revealed up until three years before entrance to the hospital he had worked for 20 polishing leather on a sandpaper wheel. There were numerous machines in work room and no precautions were observed to clear the very dusty air. sputum was examined through the kindness of Dr. Burke of Raybrook, N. Y. found it laden with numerous doubly refractile silica particles. He expressed pinion that this was consistent with silicosis for he had found such numerous cles only in cases of silicosis. The patient subsequently died of a tuberculous ngitis. Retinal tubercles were demonstrated on microscopic section. The logist's report was miliary tuberculosis. Ashing of the lung showed increased content, consistent with undue exposure to dust (more than 2 mgm. silica per dried tissue).

Case II—Mr. R., aged 54, entered the New York hospital complaining of ptyses, dyspnea and chest pain. On physical examination there were rales dullness over the upper third of the right chest anteriorly. He ran a low fever but was robust and felt quite well. The chest X-ray disclosed enlarged shadows, particularly on the right, and diffuse mottled discrete shadows

throughout both lung fields with a circumscribed density near the right apex. He gave a history of having worked for twenty-four years as a cutter and sizer of asbestos-containing paper box boards. The rooms were in a continuous cloud of dust. Examination of the dust revealed 5 per cent silica content. The hemoptysis, we felt, was to be explained on the basis of infection or neoplasm, but we did not know whether we were dealing with one of those processes alone or an associated silicosis or asbestosis. A small nodule in the neck was subsequently removed and showed carcinoma. We are inclined to believe that this does not explain the whole process, as the man is still alive and certainly, from the X-ray standpoint, we cannot say that there is no silicosis.

Case III—Mr. C. A dish-washer, aged 46, entered Bellevue hospital because of cough and expectoration, associated with dyspnea. There was some dullness and rales at the right base posteriorly. Chest X-ray revealed a homogeneous shadow at the right base. His sputum contained no tubercle bacilli and lipiodol study revealed no abnormalities. Bronchoscopic examination disclosed a bleeding mass in right main bronchus. Symptoms and disease progressed during the following four years. Discrete mottled shadows first appeared in the upper right lung field and the shadow at the right base cleared somewhat. Three years later extensive ab- normal shadows were present throughout both lung fields, particularly on the right. Diagnosis of chronic pneumonia of unknown etiology was made. At no time was a diagnosis of silicosis entertained, because as far as could be determined he had no history of exposure. Furthermore if there were silicosis it behaved very atypically having the lesion confined practically to the right base at the beginning and then spreading to the left lung. Autopsy however, revealed a typical silicosis associated with a small degree of tuberculosis. A picture of the lung showed how much more extensive the silicotic process was in the right lung. There was stenosis of the right middle lobe bronchus with bronchiectasis in this lobe. Chronic infection in the lung field probably accounted for the unusual localization. This case illustrates how necessary it is to have the history of dust exposure for without it here we are unable to even suggest a diagnosis.

Case IV—Mr. C., aged 45, complained of cough and dyspnea with slight expec- toration and gave a history of having worked for many years repairing tires, using talc powder. It was difficult to obtain accurate details as to the possibility of silica exposure except that the rooms were filled with clouds of dust. Rales were present at both apices and a few tubercle bacilli were found in the sputum. Discrete and stringy shadows were disseminated throughout both lung fields. We know from the positive sputum that tuberculosis is present. The patient has, however, been well for a period of two years. The doubtful history of exposure together with the numerous discrete nodular shadows in his lung, which are con- sistent with silicosis, makes this patient a problem. Is this tuberculosis alone or is this tuberculosis with silicosis? The patient is still living a year later and working.

Conclusion. Cases such as these are exceptional, but their existence must always be borne in mind. If occupational history is inadequate and X-ray, clinical and laboratory studies prove misleading, the diagnosis may present great difficulty. However, a comprehensive study of all possible data usually clears up the problem with reasonable certainty.

ADJOURNMENT

Safety Equipment

WEDNESDAY AFTERNOON SESSION

October 16, 1935

The session was called to order by Chairman, Irwin W. Millard, president, Industrial Gloves Corporation, Danville, Ill. Chairman Millard mentioned some of the problems of providing adequate safety equipment for industry.

Respiratory Protective Devices

(An interpretation of the U. S. Bureau of Mines, Schedule 21)

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The respiratory protective devices of industrial hygienic importance are those designed to protect against the inhalation of harmful solid, gaseous, or liquid atmospheric contaminants, or the inhalation of air deficient in oxygen.

The devices in common use are the mechanical filter respirator (commonly referred to as respirator) for protection against the inhalation of dusts, smokes, fumes, and mists or what may be referred to collectively as atmospheric particulate matter; gas masks for protection against the inhalation of gases and vapors; oxygen breathing apparatus, hose masks, and air-line respirators for protection against the inhalation of any atmosphere provided it does not contain harmful constituent which can be absorbed readily through the skin; and the abrasive blasting helmet or hood for protection against the inhalation of and the impact and abrasion from the atmospheric particulate matter generated in sand blasting or abrasive blasting with steel shot.

These devices are designed to furnish protection either by making the wearer's inspired air safe to breathe or by supplying the wearer with safe air from a supply which he carries or from outside the contaminated zone.

The wearer of the first or air-purifying type, on inspiration draws air from his immediate surroundings through the device which either removes the contaminant, usually by chemical or mechanical filtration, or converts it into a harmless substance. This type, of course, offers no protection against atmospheres deficient in oxygen as it does not add oxygen to the air.

There are two types of respiratory protective devices of the second type designed to supply the wearer with safe air. In one, the wearer receives his air supply from a cylinder of compressed oxygen, liquid oxygen, liquid air, or from a chemical which yields oxygen upon decomposition. This air supply is part of the self-contained unit, all of which is carried by the wearer. In the other type a hose, attached to a facepiece, is connected to a compressor or blower whose intake is located in safe air. Air is forced through the hose to the wearer.

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There is some confusion in the use of the term "respirator," to designate devices for protection against the inhalation of atmospheric particulate matter. Such devices were the first and for a long time were the only respiratory protective devices. They were logically called respirators, and as long as they were the only devices of this kind there was no confusion. The development of other devices of industrial hygienic importance and the development of devices for maintaining artificial respiration over long periods and for enabling men trapped in submerged submarines to reach the surface safely, all called respirators, was responsible for the confusion. The Bureau of Mines suggests that the term "respirator" be retained for all of these devices, but that respiratory protective devices of industrial hygienic importance be called industrial respirators and that the different kinds of industrial respirators be assigned a name which will indicate their operating principle or field of use or both. Satisfactory names in common use should be retained. On this basis, the Bureau of Mines suggests the following classification for respiratory protective devices of industrial hygienic importance:

Industrial Respirators

1. Supplied-Air Respirators
   - a. Self-contained type
     - (1) Oxygen breathing apparatus[a]
   - b. Hose type
     - (1) Hose mask
     - (2) Air-line respirator[b]
     - (3) Abrasive blasting respirator[c]
2. Air-Purifying Respirators
   - a. Chemical filter respirator[d]
     - (1) Acid gas or type A[e] chemical filter respirator
     - (2) Organic vapor or type B[e] chemical filter respirator
     - (3) Ammonia or type C[e] chemical filter respirator
     - (4) Carbon monoxide or type D[e] chemical filter respirator
   - b. Mechanical filter respirator[f]
     - (1) Dust or type A[g] mechanical filter respirator
     - (2) Fume or type B[g] mechanical filter respirator
     - (3) Mist or type C[g] mechanical filter respirator
   - c. Chemical and mechanical filter respirator[h]

Testing and Approving of Industrial Respirators by the U. S. Bureau of Mines

Since its organization the U. S. Bureau of Mines has been interested in industrial respirators as a means of protecting workers in the mineral industry against harmful atmospheric contaminants. To this end the Bureau has developed an approval system, the purposes of which are: (1) To encourage and aid manufacturers in the development and marketing of safe and suitable equipment; and (2) to encourage the consumer to use such equipment, to aid him in obtaining it and to instruct him in its care. These purposes are accomplished by establishing a schedule of the material and performance requirements that a safe and suitable device should meet; by making approval tests for conformance to such a schedule; and by informing the public of the

[a] Sometimes called mine rescue breathing apparatus.
[b] Sometimes called paint spray respirator or positive pressure respirator.
[c] Sometimes called sand-blast helmet or hood.
[d] Commonly called gas mask.
[e] Letters assigned to canisters of chemical filter respirators. See U. S. Bureau of Mines Approval Sched. 14D, Procedure for Testing Gas Masks for Permissibility, 17 pp., 1935.
[f] Commonly called respirator. Sometimes referred to as dust respirator or mechanical filter-type respirator.
[g] Letters assigned to mechanical filter respirator filters. See U. S. Bureau of Mines Approval Sched. 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility, 14 pp., 1934.
[h] The devices now referred to as Type N or All Service Gas Mask and the chemical cartridge respirator fall under this heading.

advantages in the use of devices bearing Bureau of Mines approval. If the device is found by examination and test to meet the requirements of the schedule the Bureau of Mines gives the manufacturer a certificate of approval[1] which he may display as evidence of the quality of his product. The approved devices are marked in a manner which clearly distinguishes them and indicates the purpose for which they are approved and the limitations under which they may be used. As an aid to the consumer, the Bureau of Mines periodically issues a list of the devices which have met the requirements.

The submission of equipment is entirely voluntary on the part of the manufacturer. On making application for tests, the manufacturer deposits a fee which is turned into the miscellaneous receipts of the treasury of the United States; none of the money accrues to the Bureau of Mines. The approval system is motivated entirely by the desire of the manufacturers to produce and market good equipment, the interest of the Bureau of Mines in having safe equipment available commercially, and the demand of the consumer for such equipment.

Approval schedules have been issued for oxygen breathing apparatus,[1] chemical filter respirators or gas masks,[2] hose masks[3] and mechanical filter respirators.[4] The schedule covering hose masks is being revised to include the other kinds of supplied-air respirators, namely, air-line and abrasive-blasting respirators. When this revision is completed, the Bureau of Mines will have approval schedules for all types of respirators now in common use. The approval system undoubtedly is largely responsible for the development of fundamentally safe and suitable devices, and the elimination of confusion in their selection and use.

The general plan of the various schedules is similar. The requirements may be divided into 3 parts:

(1) Pre-test requirements, or those with which the manufacturer must comply before examination and test of a device will be undertaken. For example, the respirator must be in a fully developed form ready for market and available for purchase if approval is granted. Also, the manufacturer must be prepared to test and maintain control of the essential characteristics of his device by a method which meets the approval of this Bureau.

(2) Material, construction, and performance requirements which the equipment must meet by examination and test.

(3) Post-test requirements, or those with which the manufacturer must comply after the device is approved. From the viewpoint of the consumer the most important of these concern labeling and marking, provision of adequate instructions for proper use of the device, and maintenance of design and quality of the product marketed under the approval. As a check on the latter, the Bureau of Mines obtains samples of the device on the open market and subjects them to the various inspections and tests of the appropriate schedule. The Bureau reserves the right to withdraw its approval of any device for cause.

Interpretation of U. S. Bureau of Mines Approval Schedule 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility

Among the reasons for the development of Schedule 21, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility, was the realization by the Bureau of Mines and others that there was a definite need for mechanical filter respirators to protect workers against harmful atmospheric particulate matter in situations where better methods of control of dust production and removal were either not available or practical, the inefficiency of existing mechanical filter respirators, and

[1] Bureau of Mines, Procedure for Establishing a List of Permissible Self Contained Oxygen Breathing Apparatus: Fees, Character of Tests, and Condition Under which Mine Rescue Breathing Apparatus will be Tested: Sched. 13A, January 21, 1930, 12 pp.
[2] Bureau of Mines, Procedure for Testing Gas Masks for Permissibility: Sched. 14D, May 9, 1935, 17 pp.
[3] Bureau of Mines, Procedure for Testing Hose Masks for Permissibility: Sched. 19, April 28, 1927, 8 pp.
[4] Bureau of Mines, Procedure for Testing Filter-Type Dust, Fume, and Mist Respirators for Permissibility: Sched. 21, August 20, 1934, 14 pp.

-ts from manufacturers and consumers that this bureau test and approve such -es.

-chedule 21 follows the general plan of the other bureau approval schedules for -rial respirators; the pre-test and post-test requirements are quite similar, and -neral principles of the test requirements are the same. The primary purpose of -aper is to explain the reasons for the various test requirements.

Pre-Test Requirements

The pre-test requirements of Schedule 21 require that the manufacturer submit -mation, drawings, and samples of the device to be tested. The device must be -letely developed and ready for release to the public, and the device when tested -he manufacturer or his agent must have passed tests of the nature described -chedule 21. The reasons for the third requirement are: (1) To assure the -au that the manufacturer is prepared to control the filtering characteristics of -espirator; (2) to eliminate any question of competition with private consulting -cies in developing respirators; (3) to furnish evidence that the respirator really -ady for release to public market; and (4) to save the manufacturer's and the -au's time. After the manufacturer has complied with all the above pre-test -irements he must submit a fee for the examination and test of his device. fee is turned into the miscellaneous funds of the U. S. treasury and none of -money reverts to the Bureau of Mines.

Test Requirements

In developing the tests for mechanical filter respirators consideration was given -to the general requirements for a safe and suitable device. These requirements similar for all types of industrial respirators. The respirator must (1) give -quate protection, (2) be reasonably comfortable and physically convenient to -r, and (3) provide an acceptable service life.

Adequate protection implies that the mechanical filter respirator when properly -tained and worn must prevent the wearer from breathing enough particulate -ter to cause a harmful physiological response under the conditions of occupational -sure for which it is designed to be used.

Comfort and physical convenience factors are equal in importance to adequate -tection. Even though aware of the ultimate serious effect which will be produced -r prolonged daily exposure, workmen are inclined to be diffident and unwilling -fter much daily inconvenience and discomfort from the respirator.

Encumbrance and discomfort also increase fatigue, cause distraction, and in -al handicap the wearer's ability to take care of himself, thus increasing the -bility of accident. Important specific items include the weight of the respirator, -arriage on the face or head, effect on vision, heating of the area of the skin -r the facepiece, inability to expectorate, difficulty in talking, and resistance to -athing. The importance of comfort and physical convenience cannot be over -ated.

The service life involves elements of practicability in the wearing and maintenance -he device, and indirectly the safety. This type of respirator is primarily not an -gency device, but a part of the workman's equipment for doing his regular job -ly. If the service life is short, the bother of changing of filter elements will -reflected in the workman's attitude toward good maintenance and use.

All mechanical filter respirators are subjected to certain inspections and tests they must fulfill certain requirements. The general design and construction, -ticularly as to facial fit, freedom from irritating facial contacts, weight, effect vision and the wearing of goggles, and ease of changing filter elements, and -mined. The materials are examined to determine if they are obviously suited the purpose for which they are designed. Rubber parts which come in contact the skin must not contain any skin-irritating constituent.

Resistance to Air Flow Requirements

[illegible] for resistance to air flow are the same for all approved me- [illegible] filter respirators. At no time during or after the filter efficacy testing period the resistance to air being drawn through the device at the rate of 85 liters

(3 cubic feet) per minute exceed 50 millimeters (1.97 inches) of water column height or the resistance to air being blown through the device at the same rate of flow exceed 25 millimeters of water column height. An air flow of 85 liter per minute is approximately equivalent to the respiratory rate of a man doing heavy work. The amount of particulate matter pulled to the device during the filter efficacy tests is roughly equivalent to the amount that would be pulled to the filter by a worker wearing the mechanical filter respirator in a moderately concentrated suspension of the particulate matter during an 8-hour period. Thus resistance to air flow of an approved mechanical filter respirator should not become excessive when worn for an 8-hour period in most suspensions of atmospheric particulate matter encountered in industry. The manufacturer is required to give instructions on cleaning or changing the filter elements when the resistance to air flow noticeably increases.

Direct Leakage and Man Test

All mechanical filter respirators are subjected to a direct leakage and man test to determine facial fit, whether there is any direct leakage of unfiltered air, and to obtain information on the comfort of the device. Three of the mechanical filter respirators are worn for 30 minutes by 3 men with different facial features in an atmosphere containing a heavy suspension of bituminous-coal dust. At the end of the period the respirators are removed and that part of the face covered by the facepiece is examined for evidence of any leak under the edge of the facepiece. Sticks a millimeter thick were wedged under the edges of the facepieces worn by subjects A and C to cause the leaks. The location and approximate magnitude of the leaks are shown by the black streaks on that part of the face covered by the edges of the facepieces. The nasal passages and sputum of the subjects are also examined before and after the tests.

Filtering-Efficacy Tests

In the development of the filtering-efficacy tests, particular attention was given to the physical properties, especially particle size, of the significant kinds of atmospheric particulate matter encountered in industry. Previous studies of filtering materials had shown that, in general, filtering efficacy decreases with a decrease in particle size.

It was decided that most of the significant industrially generated atmospheric particulate matter could be classified into the following three groups in accordance with method of generation, physical state, and particle size:

1. *Mechanically generated dusts* resulting from the disintegration of a solid, such as the dust clouds produced in the various processes of mining, quarrying and tunneling and the grinding, crushing, and general processing of solid materials. This type of atmospheric particulate matter is referred to as Type A atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type A mechanical filter respirators.

2. *Fumes* of various metals (usually their chemical compounds, as oxides or carbonates) such as lead, mercury (except mercury vapor) manganese, magnesium, aluminum, antimony, arsenic, copper, chromium, iron, cadmium, and zinc resulting from sublimation or the condensation of their vapor, or from the chemical reactions between their vapor and gases. This type of atmospheric particulate matter is referred to as Type B atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type B mechanical filter respirators.

3. *Mists* as produced by spray-coating with paint and vitreous enamels, chromic acid mist as produced in chromium plating, and other mists of materials whose liquid vehicle does not produce harmful gases or vapors. This type of atmospheric particulate matter is referred to as Type C atmospheric particulate matter and mechanical filter respirators designed to furnish protection against these suspensions are referred to as Type C mechanical filter respirators.

The mechanically generated dusts and fumes consist of solid particles while the mists consist of liquid or liquid-coated solid particles. The particle size of mechanically generated dusts extends over a wide range, in some cases, from particles visible to the naked eye probably down to molecular dimensions. The range in particle size of fumes is much smaller. The upper limit is in the lower microscopic

…nge (about 0.5 micron), while the lower limit probably approaches molecular …mensions. The particles of some fumes, particularly zinc and magnesium, readily …n and form large flocklike clusters. The effect is least pronounced in the case … lead. Mist particles are spherical and probably more uniform in particle size than …se of dusts and fumes.

Suspensions of each of the types of industrially-generated atmospheric particle …atter were selected for use in the filtering-efficacy tests. These suspensions were …hosen on the basis of their industrial hygienic significance and their physical …roperties, such as particle-size distribution and tendency to aggregate, which have … appreciable effect on filtration. It was desired to test the mechanical filter …spirators against the most common or widespread harmful suspensions of each …pe: the test suspensions to have physical properties, such as particle size and …gregation tendency, which would render them as difficult to remove by filtration … any other suspension of the same type. The test suspensions selected are:

(a) For testing Type A mechanical filter respirators or those designed to …nish protection against mechanically generated dusts a suspension generated from …ry fine (99+ per cent through 325 standard mesh sieve) silica dust consisting of … per cent free silica (SiO_2) is used. The suspension is generated in such a way …at all particles larger than about 3 microns are removed before the suspension …ters the test chamber. The particle-size distribution of the test suspension must …t exceed a geometric mean of 0.6 micron and a standard geometric deviation of …0. The particle-size determination is made by collecting samples of the suspension … the Owens jet dust counter and determining the particle size distribution by a …icroprojection method developed by the Bureau of Mines.[4]

(b) For testing Type B mechanical filter respirators or those designed to …urnish protection against fumes, a lead oxide fume generated by the combustion of …atural gas containing lead tetraethyl vapor is used. The particles of this fume are …xtremely small and have about the least tendency to aggregate of any fume, hence …ey are very difficult to remove from the air by mechanical filtration. A suspension … magnesium oxide is also used to determine the effect of a fume, whose particles …adily aggregate in large clusters, on the resistance to air flow of the filter of the …vice.

(c) For testing Type C mechanical filter respirators or those designed to …rnish protection against mists, three different suspensions are used. Chromic …id mist generated by electrolyzing an aqueous solution of chromic acid, as is done … industrial chromium plating; lead paint mist generated by spray-coating with lead …int; and a water mist carrying silica dust generated by spraying a 2 per cent …eous suspension of silica dust are used. The water-mist carrying silica dust is …d to simulate the mists generated in spray-coating with vitreous enamels.

The concentration of the particulate matter in the test suspensions was chosen … represent more or less the higher concentrations found in industry. Since the …ncentration of mechanically generated dust found in industry varies over such …de limits it was decided to test Type A mechanical filter respirators against two …ncentrations; one to represent the more or less average dusty industrial condi…ns, and the other to represent very dusty conditions.

The complete mechanical filter respirator is tested on a mechanical testing …paratus. The test suspension is pulled through the device at the rate of 32 liters … 1.13 cubic feet) per minute, continuous flow. The volume of air pulled through …e mechanical filter respirator is 10 cubic meters in all cases except in some …ts against particular kinds of suspensions as mechanically generated lead dusts …d in the high-silica dust-concentration test and the magnesium oxide test whose …imary object is to determine the increase in resistance to air flow of the filter …ith the amount of particulate matter retained. Ten cubic meters is approximately …uivalent to the volume of air breathed by a worker in 8 hours. The samples of …articulate matter for concentration determinations are precipitated electrically …om the air of the test suspension both before and after it has passed through … mechanical filter respirator. The samples are collected in containers which … be weighed readily on an analytical balance. For reasons of convenience, speed,

[4] Brown, C. E. and Yant, W. P. The Microprojector for Determining Particle Size …tribution and Number Concentration of Atmospheric Dusts. U. S. Bureau of Mines Report Investigations 3287, 1935.

and accuracy the samples of silica dust are quantitated by weight rather than by count. Samples of the other particulate matter are quantitated chemically.

The requirements as to the amount of particulate matter that the mechanical filter respirators must remove from the air pulled through them is based on the best available information on the concentration of the particulate matter that is safe to breathe. These requirements are subject to change with the accumulation of knowledge on the physiological effects of industrially generated atmospheric particulate matter. In other words, the filtering-efficacy requirement is that the air inhaled by the wearer of such a device must be safe to breathe, and not that the device have any particular percentage filtering efficiency.

Mechanical filter respirators are not approved for any substance more harmful than the particulate matter in the test suspension against which they are tested. Thus Type A respirators are not approved for any substance more harmful than free silica (SiO_2) dust. However, Schedule 21 provides for testing and approving mechanical filter respirators against any kind of industrially generated atmospheric particulate matter. For example, Type A mechanical filter respirators are not approved for protection against poisoning by breathing dusts whose main harmful constituents are metals or their compounds. However, two mechanical filter respirators have been submitted and approved for protection against the inhalation of mechanical generated lead dusts.

Table 1 summarizes the details of the filtering-efficacy tests and lists the mechanical filter respirators which have been approved to date. (Pages 140-141.)

Post-Test Requirements

The manufacturer of an approved mechanical filter respirator is required to mark his device with the name of his company, the name letter, or number by which the type is designated for trade purposes, and the approval number assigned to the device by the Bureau of Mines; and the filter unit must be marked with the approval number and with the type or kind of atmospheric particulate matter for which it is approved.

The mechanical filter respirator and replacement filter units must be provided with substantial and durable containers. Copies of the approval labels issued to the manufacturer by the Bureau of Mines must be attached to these containers. The approval label gives the approval number, shows to whom the approval is issued, states what the device is and is not approved for, and cautions the wearer to follow the manufacturer's instructions for the use and care of the device.

The following is a sample of the required instructions furnished by the manufacturer. These instructions are similar for all of the approved mechanical filter respirators.

Instructions for Use of Mechanical Filter Respirator

1. Respirators will not protect unless placed on the face properly each time they are worn. Carelessness in face-fit means dangerous leakage. In general, a better fit is obtained if the mask is worn not too high on the nose.

2. To fit the respirator to the face hold the respirator, exhaust valve pointing downward, by the metal screw connection with either hand, and hold the headstrap with the other hand. Place the facepiece against the face and hold it in place while pulling the headstrap over the head and below the ears. Then adjust the facepiece until a firm snug fit is obtained. The headstrap may be adjusted while the respirator is in place by holding the metal slide between the thumb and forefinger of one hand and pulling on the proper strap with the other hand.

3. To instruct the wearer in the proper adjustment of the headstraps and position of the respirator on the face a cardboard disc is enclosed. To use this disc unscrew the filter bag, place the disc against the felt washer in the metal connection on the felt bag, assemble the respirator, and put it on. The wearer should not be able to breathe through the respirator or feel any inward leakage of air under the edges of the facepiece.

The presence or absence of dust streaks on the face inside the line of fit of the facepiece after wearing the respirator in a dusty atmosphere can also be used to tell whether a proper fit was obtained.

4. The recommended procedure for cleaning the filter bag is to insert loosely the nozzle of a high-pressure air hose into the bag opening and to blow several

TABLE 1. DETAILS OF FILTERING EFFICACY TESTS AND LIST OF APPROVED MECHANICAL FILTER-TYPE RESPIRATORS

Kind of mechanical filter-type respirator	Industrially generated atmospheric particulate matter against which the device is designed to furnish protection	Test suspensions used	Concentration of test suspension, milligrams[a] per cubic meter[b] of air	Volume of test suspension pulled through the device, cubic meters[c]	Maximum amount of particulate matter permitted to pass through the device: Milligrams	Maximum amount of particulate matter permitted to pass through the device: Milligrams per cubic meter of air	Name and manufacturer of mec[han]ical filter-type respirators ap[proved] to date, September 25, 193[?]
Type A	Mechanically generated dusts resulting principally from the disintegration of a solid, such as the dust clouds produced in mining, quarrying and tunneling, and the industrial operations of grinding, crushing, and processing of minerals	Air-suspended ground flint, which consists of 99+ percent free silica (SiO_2). Over 99 percent of the dust passes through 325-mesh standard sieve	(a) 50 ± 10[d]	2.88	4 mg. for any 1 of 3 devices, or an average of 3 mg. for each of the 3 devices	1.0[d]	M.S.A. Comfo Respirator. Ap[proval] No. 2101, issued to Mine Safety [Ap]pliances Co. Willson Bag Respirator No. [..] Approval No. 2102, issued to [Will]son Products, Inc.
			(b) 5 ± 2[d]	9.98	12 mg. for any 1 of 3 devices, or an average of 10 mg. for each of the 3	1.0[d]	Willson Bag Respirator No. [..] Approved No. 2103, issued to [Will]son Products, Inc.[e] Pulmosan M-15 Pouch-Type [..] Respirator. Approval N[o]. 2104, [is]sued to Pulmosan Safety Equip[ment] Corp. Biever Respirator. Approval [No.] 2105, issued to Standard Sa[fety] Equipment Co.
Type B	Fumes of various metals (usually their chemical compounds, as oxides or carbonates) such as lead, mercury (except mercury vapor), manganese, copper, chromium, iron, cadmium, zinc, magnesium, aluminum, antimony, and arsenic resulting from sublimation or condensation of their vapor, or from chemical reactions between their vapor and gases	(a) Lead oxide fume produced by the decomposition and combustion of lead tetraethyl	15 ± 5 of lead	9.98	1.5	0.15	Willson Bag Respirator No. 4[..] [Ap]proval No. 2106, issued to Wi[llson] Products, Inc.[e]
		(b) Magnesium oxide fume, freshly produced by burning magnesium ribbon	100 ± 25	2	—	—	
Type C	Mists as produced by spray-coating with paint and vitreous enamels, chromic acid mist as produced in chromium plating, and other mists of materials whose liquid vehicle does not produce harmful gases or vapors	(a) Chromic acid mist produced by electrolyzing an aqueous solution (200-500 grams of chromic acid per liter) of chromic acid	15 ± 5 of chromic acid	9.96	1	0.1	M.S.A. Comfo Respirator. Appro[val] No. 2101, issued to Mine Sa[fety] Appliances Co.[e]
		(b) Lead paint mist produced by spraying a paint having the following composition: white lead (paste having approximately 91 percent white lead and 9 percent linseed oil by weight), 100 grams; linseed oil, 50 cubic centimeters; and steam-distilled turpentine, 25 cubic centimeters	200-600 of lead	9.98	1.5	0.15	M.S.A. Comfo Respirator not [ap]proved for lead containing mists
		(c) Mist produced by spraying a 2 percent aqueous suspension of ground flint, air-floated (99+ percent through 325 standard mesh sieve). The ground flint consists of 99+ percent free silica (SiO_2).	10 ± 5[d] of silica dust	9.98	5	0.5[d]	M.S.A. Comfo Respirator. Appro[val] No. 2101, issued to Mine Safety Ap[pliances] Co.[e]
...ically ...ted lead	Mechanically generated dusts whose main harmful constituent is lead, such as lead dusts generated in manufacturing storage batteries; enameling; pottery making; rubber compounding; sandpapering and chipping painted surfaces; paintmaking; preparing litho-transfers; and mining, milling and processing lead ores	Mixture used in making negative plates of lead storage batteries. Contains 72 percent litharge, PbO; 25 percent red lead, Pb_3O_4; and 3 percent lampblack	15 ± 5 of lead	2.88	0.43	0.15	M.S.A. Comfo Respirator with s[pe]cial filters for lead dust. Appro[val] No. 2107, issued to Mine Safety A[p]pliances Co.[e] Willson Bag Respirator No. [..] Approval No. 2108, issued to Wi[ll]son Products, Inc.[e]

[a] One milligram = 0.0154 grain.
[b] One cubic meter = 35.315 cubic feet.
[c] Rate of sampling = 32 liters (1.13 cubic feet) per minute.
[d] One milligram of this silica dust contains approximately 300 million particles as determined by the impinger method as described by the U. S. Public Health Service. Hence, 1 [mill]igram per cubic meter of this dust is approximately equivalent to 8.5 millions of particles [per] cubic foot.
[e] See previous listing of company for complete address.

short blasts of air into the bag. This procedure removes from the bag dust and grit which clogs the pores of the filter and makes breathing difficult. The proper time for cleaning the bag is when the wearer experiences discomfort in breathing. When compressed air is not available some dust may be removed by tapping the bag lightly and brushing the outside of the bag.

5. To prevent irritation of the skin and for general sanitary purposes the respirator should be cleaned after each day's use. The rubber and metal parts may be cleaned with soap and water, and for general sterilization they may be dipped in a 3 per cent solution of carbolic acid, a 2 per cent solution of lysol, or a 70 per cent solution of denatured alcohol, then rinsed with water, assembled, and hung up by the loop in the felt bag to dry. The filter bag and headstrap always must be removed before the respirator is washed or sterilized.

6. While not in use the respirator should be kept in a dust-free place, preferably in the original container.

The manufacturer is required to maintain the quality of his product and to see that each mechanical filter respirator in all its parts is constructed according to the drawings or records that have been accepted by the Bureau for this device and that are in the Bureau's files. Mechanical filter respirators that exhibit changes in design or include any parts that have not been approved are not permissible respirators and must not bear the Bureau's approval label. Schedule 21 provides for the manufacturer to apply for an extension of approval on any change in the mechanical filter respirator which does not affect the filtering characteristics of the filter. Changes in the filter require the application for a new approval.

The Bureau obtains information on the maintenance of design and quality of approved mechanical filter respirators by testing samples of the devices obtained on the open market. The Bureau reserves the right to rescind for cause any approval issued.

A Safety Style Show

By E. J. SMITH

Safety and Health Director, Western Electric Company Hawthorne Works, Chicago

For the purpose of assisting our foremen in the selection of the proper safety equipment we have standard specifications and every foreman has a copy. In it he will find the protective equipment required for any class of work.

Molders, cupola tenders, furnace tenders and helpers in foundry and forge are equipped with heavy duty metal or composition cup goggles with hardened lenses. The lenses in the furnace tender's goggles are of a forge and furnace shade. Electric furnace tenders, however, wear a welder's goggle, described later. When a goggle is equipped with clear lenses, it is used for such operations as breaking defective castings, cleaning castings with compressed air, grinding castings to remove gates or fins, pounding on castings to remove sand cores, pouring molten metal into molds with hand or bull ladles, removing gates or fins from castings with air chisels, or hand chisels and hammers, and working in vicinity of chipping hammers.

Leggings are of the non-lacing, non-buckling and snap buttoning type held in place by hidden steel springs similar to the old bicycle pants guard. They will come off instantly from a tug at any point. There are no gadgets to confuse you or those who are trying to help you in an emergency. Just one simple thing to remember—grab anywhere and pull.

Men wear safety hats when chipping slag out of cupolas. Our construction crews of masons, carpenters, millwrights, and so on, wear them whenever they are engaged in work where there is the slightest chance of objects falling from overhead.

Our employees wear "Congress" safety shoes for their protection in addition to the leggings.

We use a leather steel faced glove when charging a cupola or handling pig iron.

Full leather palm gloves with band top are used in chipping casting fins, loading and unloading tumbling barrels, and removing castings from sand.

For the protection of health, workers in the brass foundry are provided with overalls and undershirts with full length sleeves. This is in accordance with Illinois

Safety Section, AAR--Steam Railroad Section, NSC

Officers 1934-1935

General Chairman—T. H. Carrow, Pennsylvania Railroad, Philadelphia.

First Vice Chairman—W. H. Failing, Central Railroad Company of New Jersey Reading Company, Philadelphia.

Second Vice Chairman—C. F. Larson, Missouri Pacific Lines, St. Louis.

Members of the Committee of Direction:

Eastern Territory—H. R. Cole, Erie Railroad, Cleveland, Ohio; Charles E. Hill, New York Central Lines, New York City.

Western Territory—L. F. Shedd, Chicago, Rock Island and Pacific Railway, Chicago.

Southern Territory—D. H. Beatty, Southern Railway, Washington, D. C.

Secretary—J. C. Caviston, Association of American Railroads, New York City.

Officers Elected for 1935-1936

General Chairman—C. F. Larson, Missouri Pacific Lines, St. Louis, Mo.

First Vice Chairman—E. A. Meyer, Chicago, Milwaukee, St. Paul and Pacific Railroad, Chicago.

Second Vice Chairman—E. G. Evans, Louisville and Nashville Railroad, Louisville.

Members of Committee of Direction:

Eastern Territory—A. O. Beck, Canadian National Railways, Montreal; H. A. Rowe, Lackawanna and Western Railroad, New York City.

Western Territory—F. W. Curtis, Denver and Rio Grande Western Railroad, Denver.

Southern Territory—L. G. Bentley, Chesapeake and Ohio Railway, Richmond, Va.

Secretary—J. C. Caviston, Association of American Railroads, New York City.

A complete report of these sessions is published by the American Railway Association in a booklet entitled, "Proceedings of the Fifteenth Annual Meeting of the Safety Section, Louisville, Ky., Oct. 15 to 17, 1935." Copies of the booklet are available from the Association of American Railroads, N. Y. C. The following is a condensed record.

TUESDAY MORNING SESSION

October 15, 1935

The opening session of the Safety Section, Association of American Railroads—Steam Railroad Section, National Safety Council, was called to order by General Chairman T. H. Carrow, Supt. of Safety, Pennsylvania Railroad, who presided.

From the following it will be gleaned the situation on our railroads has improved perceptibly with regard to the trespassing evil, particularly when consideration is given to the fact that our population has increased and operation accelerated.

Years	Killed	Injured	Totals
1901 to 1910	50,025	53,427	103,452
1925 to 1934	24,951	30,200	55,151
Decrease	25,074 (50%)	23,227 (43%)	48,301 (46%)

Seeking an answer to these decreases, the following comes as the result of investigations:

(a)—Safety education in the schools, promoted to a great extent through activities of the railroad safety departments.

(b)—Protective measures adopted by railroad police departments.

(c)—Introduction of other modes of transportation brought about by improved highways and the practice of hitch-hiking.

Persons entering upon property occupied by another, in the absence of any contractural relationship between them, necessarily come under one of three distinct classifications or categories. (1) Invitees; (2) Licensees; (3) Trespassers; and the duty the occupier owes to any such person is graduated in strict accordance with the category to which such person belongs.

Toward trespassers the occupier owes no duty. The trespasser goes on the premises at his own risk and the occupier is liable only for acts done with the deliberate intention of doing harm to the trespasser or with reckless disregard of the presence of the trespasser.

The very nature of our business and the vast amount of territory covered by tracks, terminals, yards and stations renders the problem of trespassing unusually difficult. The impossibility of policing all these properties every hour of the day and night, is apparent. The best we can hope to do in that direction is to extend the services of our special officers, guards and watchmen as far as they will go, and rely upon these men to inculcate the spirit of watchfulness into all officers and employees so that trespassing will be held to a minimum.

Trespassing by our better class of citizens who sometimes do it unwittingly is capable of being controlled by active interest on the part of our agents or representatives.

Trespassing by school children can be partially cured by appealing to parents and school authorities. This plan has been tried out on many railroads with success.

As to what might be termed "general trespassing" on railroad premises, it is conceded that an appeal through the press, and by continually reminding the public that hazards exist wherever there are moving engines and cars, is by far the best method known for correcting this evil.

The use of bulletins and posters should commend themselves to all railroads interested in breaking up the practice of trespassing.

TUESDAY AFTERNOON SESSION

October 15, 1935

Value of Accident Prevention

By FRANK WENTER, JR.

General Claims Agent, Chicago & North Western Railroad

In the early days accident prevention activities on the American Railroads were confined to the safe delivery of the trains over the road, and these activities in time were consolidated in our present Book of Rules. This apparently was the only safety portant rules that are not being enforced, and I want to quote Mr. W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission, in what he said last year—"An operating officer assumes a grave responsibility if, in his desire to expedite the movement of traffic, he permits violations of rules to go uncorrected."

WEDNESDAY MORNING SESSION

October 16, 1935

Address

By JAMES J. DONOHUE

Claims Attorney, Louisville & Nashville Railroad, Louisville, Ky.

More than three decades ago, President Theo. Roosevelt, Gifford Pinchot, of Pennsylvania, his brother Amos, and others began to preach the preservation of the natural resources of our country, and since then we have heard much in regard to the conservation of coal, timber, iron, oil, copper, and the precious metals. But to me it has always seemed strange that it was not until 1910 that any organized, concerted effort was made to conserve the most precious things in the world—the lives and limbs of our men, women and children. In that year the National Safety Council was born, and there was then begun and intensively carried out a well-organized campaign to instill into the minds and the hearts of the people of America the principles of safety—safety not only on our railroads and in our manufacturing plants, but in the homes, on the streets, in our schools, and at other places where accidents involving personal injuries are likely to happen. To my mind, the National Safety Council, after the American Red Cross, is the greatest humanitarian agency in this country.

In no other industry has the doctrine of "Conservation of Men" been more intensively and intelligently applied than in the railroad world. In the old days, casualties were considered inevitable; it was thought that they were all in a day's work and were bound to happen, no matter how well regulated or efficiently operated the particular railroad might be. How utterly fallacious this theory was, you are able to demonstrate by pointing out the constructive work your organization has done in the past twenty-five years.

It is now well recognized that "railroading" is not extra-hazardous when conducted by prudent, careful men, but that when railroad operations are in the hands of the reckless, the dare-devil, and the chance-taker, it is hazardous in the extreme. Railroad managements, now more than ever before, exercise care to furnish employees with tools that are safe and in good condition, and with a safe place in which to work, safeguarding that place in every way practicable. In addition, railroad supervisory officials, safety committees, and employees acting in co-operation with such committees, are endeavoring, in season and out of season, to bring safety lessons home to the individual employee, through the written and the spoken word and through the medium of apt posters displayed in conspicuous places about shop and yard.

The very nature of my calling makes me prefer to talk to you in dollars and cents. In 1927, fatal and nonfatal cases cost the Louisville & Nashville Railroad Company $1,001,511.56, while in 1934 the cost was only $315,055.88. These figures tell their own story, looked at through the glasses of a humanitarian or through those of an economist. They reflect a casualty decrease of from 21.38 per million-man-hours worked in 1927 to 5.45 per million-man-hours worked in 1934. To Mr. Earl G. Evans, to our operating officials, and to the rank and file of our employees I take off my hat and felicitate both him and them with all my heart. Our experience

Accident prevention is a problem that will be solved primarily by individual action. We will never have adequate protection for human life until the manufacturer insists on safeguarding every machine before it is offered for sale; until the employer insists on safe equipment and safe methods of performing every job; until the worker makes safe practices a part of his sub-conscious habit; until the motor car driver becomes as courteous as he is in his home or office.

Permit me to cite just one illustration. Not long ago in a large gas plant, an executive of the company attempted to enter the plant while smoking a cigar. The gateman, not aware that this individual was the vice-president, flatly refused him admission until he had deposited his cigar in a metal refuse container provided for that purpose. This gateman fully understood his personal responsibility and lived up to the confidence reposed in him by his employer.

But, you might ask, can we bring about such a change in the habits and customs of 130,000,000 people? Can we get each person voluntarily to assume his share of the responsibility for the prevention of accidents? The answer to these questions, in my mind, is unqualifiedly "yes."

How? By continuing the same methods and procedures which have been employed so successfully during the past decade or more by our leading railroads and industrial organizations. In each location, in each industry, the work was started by one or two far-thinking individuals sometimes called safety men.

WEDNESDAY AFTERNOON SESSION

October 16, 1935

Transportation By Rail—Speed With Comfort and Safety

By ROY V. WRIGHT

Managing Editor, "Railway Age"

We are in the midst of a speed age. Records of travel—in the air, and on the rail, highway and water—are being broken with such frequency that announcements of new records have lost much of their old force in challenging our attention.

With the introduction of the private automobile on a large scale and the increasing use of the motor bus and the airplane with high speeds, the railroads have steadily lost passenger business for many years, although the trend started to turn back upward slightly in 1934. In that year, however, it was less than 18 billion passenger-miles, as compared to an average of 31¾ billions for the five years 1926-1930. A further increase will be registered in 1935. Railroad managements realize that they face serious difficulties in attempting to build up their passenger business, and that only by unusual and spectacular efforts, based on high standards of service, can they stage a comeback.

The public demands fast transportation, both passenger and freight. The demand for speed, as a matter of fact, has predominated over the demand for safety. Air traffic has continued to grow, and the speed of highway traffic has increased tremendously. However, the cost in human lives of this speed is startling.

An increasing proportion of the public, it would appear, is going to demand safety in travel, along with speed, comfort and convenience, and reasonable price. What are the railways doing to meet this demand?

The answer, in a broad way, is the provision of facilities over which modern and specially designed equipment can be operated successfully at high speeds with a maximum degree of safety. This may appear difficult, but a study of developments indicates that the foundations have been well laid for a more intensive development of rail transportation at this time.

The rapid extension of the railroads, in the effort to open up and develop the interior and far parts of the country, slowed up in the early part of the present fatalities is concerned. However, there were 5,794 automobiles registered for each crossing injury, and this record is not so favorable.

Your committee again recommends that individual railroads particularly stress the necessity of their train crews and others giving *adequate and timely warning to the public of the approach of trains to a highway crossing;* that *warning from engine should be continued until the crossing is definitely reached;* that the standards of protection established by the Joint Committee on Grade Crossing Protection be employed where necessary at crossings to facilitate uniformity and public understanding of the signals; that crossings be periodically inspected and maintained in sound, travable condition with all obstructions to the view removed wherever practicable; that advantage be taken of the opportunity to address school children and students of colleges and universities on the subject of railroad-highway crossing safety, no opportunity being lost to present the subject at luncheon clubs, automobile clubs, and any places where automobile drivers may gather.

THURSDAY MORNING SESSION

October 17, 1935

Report of Committee on Non-Train Accidents

By E. B. PERRY

Assistant to General Manager, New York, New Haven & Hartford Railroad

The reduction of over 46 per cent in non-train accidents to employees on duty, accomplished in the past three years, is gratifying. However, the very fact that material reductions have been so readily made supports the belief that a large decrease from the 1928 figures is still easily possible.

We have felt that no good purpose would be served by a mere recital of statistics. That which has happened cannot be corrected but should be used as a basis for thought and action to prevent recurrence. Your committee are agreed that they should outline plans for the future rather than recite history.

A review of the statistics indicates the major causes of non-train accidents fall into the following classes:

Use of hand tools, apparatus, etc.; Collapse, fall, etc., of objects; Handling rails, ties, bridge timber, etc.; Handling freight and supplies; Falls of employees not includible in class (a) to (1).

(Report had been distributed in advance to all delegates.)

There has been a marked and steady decline in non-train accidents per million man hours worked—the 1933 figures being the lowest on record.

Use of Hand Tools and Apparatus

By H. R. COLE

Assistant to Vice President, Erie Railroad

All tools and machinery should be inspected at least monthly. Proper tools should be used for different classes of work. Reclaimed tools such as clawbars, cold chisels, etc., should be thoroughly tested before placing in service. New men should be instructed in the use of tools and how to keep them in proper condition. Tools should not be left in dangerous places where employees may fall over them.

Metal spurs should be used on ladders. The use of a rubber collar on cold or hand chisels to prevent pieces of material from flying is suggested. A 50 ton air jack can be used at wheel pits eliminating use of jacks with lever which might slip.