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Incorporated

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Publication Plan

THE TRANSACTIONS of the Twenty-third Annual Safety Congress, National Safety Council, 1934, are published in two volumes. The first, containing the General Sessions, the Special Subject Sessions, and the Industrial Section Sessions, is presented herewith. It is supplemented by a smaller volume containing the sessions of the Street and Highway Traffic Section, the Child Education Section, and Home Safety.

The large volume is being sent automatically to the Industrial members of the Council; the smaller volume is sent automatically to members who are believed to be chiefly interested in those sessions. It may also be secured on request by other Council members.

For the benefit of many members who have found it advantageous to distribute copies of these **TRANSACTIONS** to supervisors, foremen and others among their personnel, who may keep them for continuous reference, the following quantity prices are quoted: 1 to 10 copies of the large volume, $1.50 each; 11 copies and over, $1.25 each. Copies of the smaller volume, $.50 each.

THE PLAN OF PUBLICATION is the same as that followed for the last three years. It is a condensed record. The papers of each session or division of the Congress have been assembled, edited with care and discernment to eliminate extraneous matter and abbreviate the less essential portions, and the concise remainder is presented for study and reference. Although not "complete" in the sense that every word is reproduced, it is an interesting and valuable record which emphasizes the memorable parts of each paper or address. The original manuscripts are on file in the Council Library, available for additional reference as desired.

Although the National Safety Council endeavors to eliminate from discussion at its conventions matters which are not pertinent to its purposes or which are contrary to its policies, the Council cannot accept responsibility for the views expressed either in the papers presented or the discussions thereon.

NATIONAL SAFETY COUNCIL, INC.
20 North Wacker Drive, Chicago

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Council Purposes and Policies

The fundamental purpose of the National Safety Council is to conserve human life. It seeks this goal through a continuous campaign of accident prevention that is nationwide in scope, applies to all lines of hazardous activity, and directly or indirectly reaches our entire citizenry. It is a non-profit organization non-sectarian, and free from political affiliations. Since its organization in 1913, it has won respect as an essential national institution.

Inseparable from accident prevention is the Council's work in improving health conditions and preventing vocational diseases in American industry.

Today there are 4,000 members, representing every state in the Union, and many of the Canadian Provinces. There are 400 foreign members. The membership includes industrial corporations, firms, individuals, public officials, schools, chambers of commerce, clubs and civic organizations. About 70 per cent are industrial concerns, including the big steel companies, the oil companies, most of the railroads in the United States, the automotive industry, and others of outstanding importance in our national industrial field.

Origin and Growth

The history of the Council is an absorbing story. Unfortunately it cannot be detailed here. Suffice to say that the *First Co-Operative Safety Congress* was held under auspices of the Association of Iron and Steel Electrical Engineers in Milwaukee, in 1912, and, as a result, the National Safety Council was organized in New York the following year with fourteen members. During the first year the membership increased to 971.

The pioneers of American safety went to work on the sound premise that accidents were an unnecessary part of our social order and that through application of proper remedial measures they could be avoided. They set about to nationalize this theory, and to develop the detailed methods and materials through which accidents could be prevented. The members of the organization now are more than ever convinced that accidents are unnecessary and that they can be and are being prevented. Striking examples of reductions in many different fields prove this contention.

Results of Organized Safety

Since the National Safety Council was organized in 1913, the national accident death rate in all fields excepting motor vehicle has been reduced 42 per cent. The motor vehicle accident problem continues to be a serious one. While there was a slight decline in fatalities in 1932—the first drop that ever occurred—1933 witnessed a slight increase, and the rise has been so accentuated during the first three-quarters of 1934 that the year will probably represent a new all-time high. Better-than-average results in motor vehicle safety have been achieved among school children, in commercial vehicle fleets, in states with properly administered drivers license laws and in cities with an effective community safety organization. These bright spots indicate that the national problem can be solved by a careful study and application of the methods which have already produced results.

The National Safety Council was started as an industrial safety organization and the best results are to be expected in this field. Here spectacular achievements have been made. The steam railroads, for instance, have reduced the accident rate among employees 75 per cent during the past ten years. A group of our largest steel industries have cut their accidents 90 per cent since 1913. Every year, scores of industrial establishments go through the entire year without a single disabling injury among their employees.

Along with these reductions the whole psychology of accidents has changed. Employer and employee both look at the proposition from a different viewpoint than they did some two decades ago. Accidents now are really out of date. In many

WHEREAS, there is such pressing need for prompt executive action to put these measures into effect and stop these needless tragedies;

THEREFORE BE IT RESOLVED: That the National Safety Council respectfully urges the President of the United States to call the Governors of the several States into conference as early in the new year as practicable, to lay before them the seriousness of the situation, the remedies which have been developed for correcting these conditions and the necessity for prompt and united action in all the States to adopt and more energetically carry on an effective program for the protection of life and limb on our streets and highways.

By formal motion, and by a rising vote, the entire audience of delegates and guests approved this action of the Council Executive Committee.

Following this, Lt.-Col. Reninger read the following letter received from the President of the United States:

THE WHITE HOUSE
WASHINGTON

September 27, 1934

My dear Mr. Long:

I wish to extend to the members of the National Safety Council, in session at the twenty-third Annual Safety Conference, my most cordial greetings and my heartiest good wishes for the success of your endeavors.

The fact that you are concerning yourselves with saving life, that you are keeping in view human values and personal security commends your program to the entire country.

I am greatly impressed and pleased with the constructive steps already taken toward the elimination of accidents, especially highway disasters, which, because avoidable, are doubly tragic. This is a problem which we must attack with the utmost energy and persistence. Ultimately we may expect to reach the solution of highway safety, provided complete cooperation on the part of all citizens is given to concerted efforts of groups such as yours. At present the rising toll of fatalities on roads and city thoroughfares indicates in a manner all too grim that we are still far from the goal.

American automotive developments and our unequalled system of highway communications which have given signal contributions to our convenience, pleasure, and commerce, must not be permitted to devolve into instruments of death and disaster.

I assure you of my keen personal interest in your efforts and commend your splendid program to induce cooperation among every citizen in our nation with the movement looking to the prevention of needless fatalities—a drain upon our most precious natural resource which must be ended.

Very sincerely yours,

FRANKLIN D. ROOSEVELT.

Mr. John E. Long,
President, National Safety Council,
c/o Cleveland Hotel,
Cleveland, Ohio.

President John E. Long then arose and introduced Mr. Harold G. Hoffman, Commissioner of Motor Vehicles of New Jersey, who presided as Toastmaster. His witty introduction of the speaker of the evening, Dr. John L. Davis, of New York City, was highly appreciated by the big audience; and was only surpassed, perhaps, by the brilliant address of Dr. Davis, himself.

Dr. Davis was listed in the program to speak on "The Spirit of America." Despite this handicap, he seized the opportunity to present a highly popular monologue—so popular in fact that his success mounted steadily throughout the evening; and it was readily agreed, after an hilarious session, that no banquet of the Council had approached this for many a year.

ADJOURNMENT

Dust in Industry

FRIDAY AFTERNOON SESSION

October 5, 1934

The session devoted to a discussion of Dust in Industry was called to order by Dr. E. G. Meiter, Director, Industrial Hygiene Laboratory, Employers Mutual Liability Insurance Co., Milwaukee, who presided. Dr. Meiter briefly welcomed the delegates and then introduced the first speaker.

Types of Dust That Cause Occupational Diseases

By LEROY U. GARDNER, M.D.

Director, Saranac Laboratory for the Study of Tuberculosis, of the Edward L. Trudeau Foundation, Saranac Lake, N. Y.

The speaker said in part: Experience has demonstrated that the lung tissues can tolerate very large amounts of most kinds of foreign dust particles without serious interference with function. The lung may be intensely pigmented by colored dusts with no evidence that respiration is impaired. But dusts composed, in whole or in part, of silica have been shown to be dangerous because they stimulate the growth of the connective tissues of the lungs and bring about the formation of scar tissue. This destroys the normal elasticity of the organ which is necessary for respiration and it thickens the delicate membranes so that a free interchange of gasses is impeded. Fortunately, these results only follow the prolonged inhalation of very large quantities of silica.

Experiments have demonstrated that the injection of silica into the tissues of animals kills the cells where the substance lodges and excites an inflammation. When healing takes place a very dense and characteristic kind of scar tissue forms. Most non-siliceous dusts produce no inflammation and very little scar. It has been shown that such changes do not follow the injection of silica unless the particles are very fine, three microns or less in diameter, and unless enough of them localize in one area. With larger particles the rate of reaction is so slow that little change occurs within a year. As a general rule, the finer the particles, the more rapid the cellular response. The reaction to fine silica begins within four or five hours and it continues for a period of years.

If the silica is combined with bases in the form of silicates, it rarely produces such active and progressive changes. The silicate of magnesium, ashestos, does cause the formation of scar tissue in experimental animals and in the human lung, but most other silicates are not generally recognized as irritating. Recently it has been claimed that a hydrated silicate of aluminum and potassium, called sericite, is responsible for most of the cases of silicosis. This silicate, a transformed feldspar, is often associated with quartz and it has been identified in the lungs of persons suf-

fering from silicosis. However, at least two types of sericite have failed to excite significant changes when injected into animals. Experiments with this substance are still in progress. Kaolin, an alumino-silicate of potash, has also produced quite characteristic changes in the lungs of rabbits. But our present knowledge does not permit us to assume that silicates as a class will produce serious tissue damage.

Most observers now believe that uncombined silica, or quartz, is poisonous to the tissues because it is slowly dissolved in the fluids of the body. Certainly the majority of the experimental observations suggest a chemical injury, but it is difficult to understand how enough of such an insoluble substance as quartz could be dissolved within eight hours to produce a well marked, acute inflammation. If solubility were the only factor one should discover a more active response after the injection of the more readily soluble silicates, but such is not the case. Formerly it was held that silica produced its effect mechanically. The hard sharp quartz particles were believed to abraid the lung surfaces and excite the formation of scar tissue as a manifestation of healing. This theory is no longer tenable for when animals are injected with other hard, sharp particles like diamond, carborundum or aluminum oxide, there is no inflammation and practically no formation of scar tissue. Ultimately it may be shown that the irritation of silica is due to some unrecognized property possibly related to its atomic structure.

When quartz particles are inhaled they produce three specific effects which are not excited by any other type of dust yet studied. They alter the behavior of the pulmonary phagocytes; they stimulate the formation of circumscribed nodules of scar tissue; and they subsequently increase the susceptibility of the lung to infection, especially tuberculous infection.

Phagocytes that ingest too many quartz particles are killed by this irritating substance. As the cells die they liberate their burden and several new phagocytes come out to take it up again. By a repetition of this process enough phagocytes accumulate so that many of them ingest only a few particles. Under such circumstances the stimulus is not strong enough to kill but merely accelerates the motility of the cells. They naturally tend to leave the air spaces, enter the lymphatic vessels and accumulate in the lymph nodes. This process becomes more rapid under the influence of the irritating silica and very considerable numbers of particles are consequently localized in the nodes.

After six or eight years the quartz in the nodes has caused a marked overgrowth of the fibrous elements in these structures. Ultimately the reaction develops to such an extent that the node is entirely replaced by a mass of coarse, glassy scar tissue fibres, often several times as large as the original node. Such nodules encroach upon and compress the lymphatic vessels. The drainage system of the lung is choked and effective removal of subsequently inhaled dust is gradually diminished. Dust now accumulates around the lymph vessels and sheets of scar tissue develop in this location.

These preliminary changes do not constitute the disease, silicosis; they involve only the lymphatic system. The respiratory tissues are not appreciably affected. In good stereo X-ray films these preliminary changes may be visualized as a thickening and beading of the shadows cast by the blood vessels together with a widening of the shadow of the root of the lung. The blood vessels are thickened because the most important lymphatic vessels course through their walls. The beading is due to the minute nodules of silicotic scar tissue in the lymph nodes within the lung. The root shadow is widened because of the silicotic reaction in the lymph nodes in this location.

If still more dust is inhaled it can no longer be effectively carried off through the lymph vessels. The phagocytes now carry it into the walls of the air spaces. Often the cells group themselves in nodules but sometimes they are scattered. In these locations the silica again stimulates the formation of scar tissue. The result is a general thickening of the septa between the spaces and nodulation throughout the functional portion of the lung. This change seriously interferes with function as interchange of gas cannot take place through the thickened walls of the air spaces and the tissues lose their normal elasticity. Less involved air spaces dilate and their walls stretch, producing the condition known as emphysema, which is also incompatible with effective respiration.

With the formation of silicotic nodules in the functioning parts of the lung the

disease, silicosis, is said to begin. On the X-ray film such nodules cast clear cut, round shadows. As they increase in number and size they blot out the formerly accentuated linear shadows of the blood vessels. In a well marked case both lung fields may be thickly seeded with hundreds of such sharply defined, rounded, nodular shadows. Where there is emphysema, often at the bases, no markings are visible and the film appears black.

The condition of silicosis is a progressive one and it continues to develop after a man has left his dusty occupation. Serious results only follow, however, when he leaves with many nodules in the lung tissue itself. As such nodules increase in size they replace important functional elements. Obviously the continued growth of only a few nodules situated in the lymphatic system could have little effect other than to increase the obstruction already present.

The serious part of silicosis is its frequent complication by tuberculosis. This may arise from reactivation of a pre-existant latent infection or it may result from a new infection from without. The danger of infection increases with the amount of silicosis present. The course of the infection in the silicotic is usually chronic and it often fails to produce characteristic symptoms for months or years after its onset. Many times it is accidentally discovered in routine X-ray examination of groups of active workmen. However, evidences of disability are much more marked in silicotic individuals with infection than in those with uncomplicated disease. Occasionally tuberculosis may run a very acute course in the silicotic subject but this is also true in other persons. The cause of the susceptibility of the silicotic lung to tuberculosis is not perfectly understood, but it would seem that the action of the silica on the tissues creates a medium favorable for the growth of the bacteria. The tubercle bacilli multiply and a slowly progressive tissue reaction ensues, but the usual clinical symptoms of tuberculosis are often held in abeyance for a long time because the chances for absorption of poisonous products of infection are minimized by the obstructed lymphatic system. It is also possible that some of these poisons may be absorbed on the silica particles, as Cummins has suggested. Ultimately the infection gains the upper hand, symptoms develop and death from tuberculosis ensues.

The only other type of dust which is generally recognized as a cause of severe pulmonary injury is asbestos, a silicate of magnesium. This substance is fibrous in character and is more readily soluble than quartz. Apparently the protective upper respiratory mechanisms seem inadequate to prevent the inhalation of many such fibres and even quite long ones may penetrate into the finer bronchial tubes. These structures have irregularities in their walls which seem to hold the fibrous dusts. In this location the asbestos particles are surrounded and ingested by phagocytes. The cells do not seem to be particularly irritated for they are not especially numerous nor do they migrate rapidly into clumps as in the case of phagocytes dealing with quartz. Apparently most of them carry their burden of asbestos fragments directly into the walls of the tubes in which they lie. The mildly irritating dust sets up a proliferation of the connective tissue cells in the walls resulting in collar-like thickening of the tubes. Contraction of the new connective tissue narrows or closes the tube and thereby shuts off the ingress of air to the more peripheral air spaces. These spaces then collapse, a condition known as atelectasis. This in itself is a cause of fibrosis or scarring of lung tissue. The result is a fibrosis of numerous relatively small areas in the lung due to the collar-like constricting fibrosis about many small terminal bronchial tubes. The lymphatic system seems to play little part in disposing of asbestos dust and very insignificant amounts of this dust are found in the lymph nodes.

Not a few cases of asbestosis die of tuberculosis or bronchopneumonia but the prevalence of the former infection is probably much less common than in silicosis. Surveys of large groups of asbestos workers fail to reveal such a high incidence of tuberculosis as found in similar studies on silica workers.

The inhalation of unusual amounts of non-siliceous dusts apparently fails to produce significant alterations in the lung. It is of course possible that injurious ones may ultimately be discovered, but none are recognized today. The non-siliceous particles enter the lung and are ingested by phagocytes as in the case of quartz. The cells are not stimulated to move very rapidly and as a consequence many of them remain within the air spaces for a long time. Some, particularly those con-

taining relatively few particles, make their way into the lymphatic system and accumulate in the lymph nodes. In sufficient concentration, or perhaps because they are mixed with small amounts of silica, they set up a low grade, non-progressive chronic inflammation. But this reaction results only in a little thickening in the lymph nodes and about the lymphatic vessels. The lung tissue may be variously pigmented, black from coal or red from iron, but there is no formation of scar tissue that interferes with function. The susceptibility to tuberculosis of the person with such pigmentation is not increased but it is apparently quite definite that pneumonia is unduly prevalent in coal miners and that chronic bronchitis results from the inhalation of cement. The X-ray films of men working in non-siliceous dusts shows either nothing at all or a more or less marked accentuation of the linear shadows cast by the blood vessels. This, of course, is due to the chronic inflammatory changes about the lymphatic trunks in walls of blood vessels.

The effects of mixtures of free silica and non-siliceous materials are less clearly defined and should receive more serious attention. It would seem unwise to assume, as has been done in the past, that the non-siliceous substances serve only as inert diluents and that only the quartz component of a dust is of significance. Experimental and clinical data are accumulating which suggest that at least some other dusts may materially modify the action of quartz, both in its capacity to produce nodular fibrosis in the lungs and to increase the susceptibility to tuberculosis. For example, animals inhaling heavy concentrations of a mixture of equal parts of pure silica and hematite dust for eight hours a day over a period of 14 months have shown not even the slightest indication of nodule formation in the lung, whereas pure quartz dust, inhaled for only two hours a day, produces definite nodulation. It also seems to be true that animals inhaling such a mixture are much less susceptible to tuberculosis than those exposed to pure quartz. In the case of the human iron miner, some lungs show definite silicotic nodulation, others only a very few nodules and many no nodules at all. All exhibit heavy deposits of iron particles with a cellular connective tissue reaction. When these findings can be correlated with chemical analysis of the lung tissues and the approximate amount of rock work which these miners have performed, some relationship between the exposure to silica and the fibrous nodule formation may be established. Tuberculosis in these iron miners is apparently less prevalent and much less severe than in men exposed to pure silica. What has been said of iron miners is also probably true of foundry workers and coal miners. It is generally accepted that men in the latter occupation have less tuberculosis than the average for the age period; Cummins believes that they have the infection but that it is so atypical and benign in its manifestations that it escapes diagnosis.

Mention should also be made of mixed dusts like certain slates and granite containing large amounts of free silica in combination with silicates. Experimentally these substances behave atypically and do not produce nodular fibrosis unless there is complicating infection. The same may also be true in human beings. Unquestionably such dusts are capable of producing typical silicotic nodules and they predispose to tuberculosis. From a theoretical standpoint they should receive much more intensive study to clarify our views on the whole subject. At the present time it appears that the action of their quartz component is modified and partially neutralized by the other substances which they contain.

Using Exhaust Systems and Respiratory Equipment To Protect Workers Exposed to Dust

By STUART W. GURNEY and DAVID S. BEYER

Liberty Mutual Insurance Company, Boston

The speaker said in part: A number of our states have had references to dust elimination in their labor laws for a good many years, but no state has as yet thoroughly enforced these laws. The codes of five states which we investigated provide that grinding, buffing and polishing wheels should be exhausted, although two of the states exempt from these provisions wheels on which water is used.

This seems ill-advised, since a study of wet and dry grinding in Connecticut by Winslow and Greenburg has shown that the application of water does not by any means eliminate the dust hazard.

It may be remarked that, with everything else equal, a high static suction will give a higher velocity at the point of origin of the dust, fume or gas than a low one; but this alone is not a measure of the effectiveness of any exhaust system. Wisconsin has adopted the principle of specifying a limit to the number of dust particles of respirable size per cubic foot of air. After all, this is what we are primarily interested in, to keep the dust contamination down to a point where it will *not be harmful.*

These variations and conflicting provisions in state codes merely reflect the general lack of authoritative standards. It is accordingly fortunate that definite steps are now being taken by the American Standards Association to develop the proper basis for such codes. There are two committees working on this problem; the Ventilation Code Committee, sponsored by the American Society of Heating & Ventilating Engineers, and the Exhaust Code Committee, sponsored by the International Association of Industrial Accident Boards and Commissions. It is also arranged to appoint sub-committees to take up five specific subjects: Abrasive cleaning, chromium plating, granite cutting, rock drilling, and spray coating. In addition, a Sub-Committee on Fundamental Principles of Design and Operation and Maintenance of Exhaust Systems will be appointed.

The two most important considerations in an effective exhaust system are: 1. Velocity of air flow; 2. Arrangement of the inlets (from the standpoint of nearness to the dust source, shape, etc.).

Many an installation that is otherwise all right fails to remove the dust successfully merely because there is not enough air being drawn through the system. In a series of tests that were conducted under actual working conditions by Theodore F. Hatch, Department of Industrial Hygiene, Harvard School of Public Health, a machine used in dressing stone was employed, and it was noted that with an air flow through the hood of 230 cubic feet per minute, there were over one hundred million dust particles in the surrounding air. When the air flow was increased to a little over 250 cubic feet per minute, the dust concentration had dropped to forty million, a marked improvement. As the air flow was further increased, the drop in dust concentration was relatively slower, and it took a volume of about 380 cubic feet per minute to bring the dust concentration down to ten or fifteen million particles per cubic foot, which was considered reasonably safe for this type of dust.

It is accordingly possible sometimes to take an installation that is not satisfactory and, if the remainder of the system is well designed, by merely speeding up the blower or adding a larger one, to bring about the desired results.

Another very important consideration is to get the inlets of the exhaust system as close as possible to the source of the dust. The drop in efficiency as we get further away from the inlet is really surprising to one who has not studied the principles involved. It should be remembered that if we have the open end of an exhaust pipe or air duct in operation, the air tends to flow in from all sides, even from behind the opening. As we move away from the end of the pipe, the velocity drops very rapidly, so that even at a distance of five inches from the hood the velocity may be less than 10 per cent of that right at the hood inlet. This is the most important consideration to keep in mind and one which is frequently lost sight of in designing exhaust systems. It is not uncommon to see an exhaust inlet a few inches in diameter with which the person making the installation hoped to draw dust from a distance of several feet, but the air flow even a foot or two away from the entrance to the inlet may be negligible.

Still another important consideration having to do with the design of the inlet, *is the addition of a flange.* The effect of this flange is to cut down the air that would flow in from behind the opening, thus drawing it nearly all from the front. Thus the efficiency of the system is substantially increased and the scope of the exhaust extended appreciably, without increasing the power consumption or otherwise adding to the expense of keeping up the system.

There are also other considerations of perhaps lesser importance. For example, air cannot be "pulled" from a distance by merely directing an exhaust pipe toward the point in question, but it can be "pushed" or blown, directionally, for a consider-

able distance. This principle may be used advantageously in directing the dust toward the opening of the exhaust inlet and thus getting the desired results with a lower exhaust velocity and power consumption than would be required if suction alone were depended upon. This principle has been applied effectively in drilling material containing asbestos, where the exhaust inlet is placed at one side of the drill and a small air jet at the opposite side of the drill, blowing across the table, turns the particles that would fly out from this side and directs them back into the exhaust system. It is also being applied to foundry shake-out work.

Other considerations in designing exhaust systems include the elimination of unnecessary bends or curves, the provision of clean-out doors, and the proper construction of joints. Where there is a general ventilating installation and one or more exhaust systems, care must be taken to see that they do not conflict with each other.

After an exhaust system has been installed it should be tested by taking actual dust counts to see that the dust is really being cut down to the desired point, and such counts should be taken at intervals after the installation has been made, to see that it is still functioning properly.

The fact that the dust particles that cause the trouble are so small that they are invisible under ordinary conditions (less than 10 microns or 1/2500th of an inch in diameter) often makes it hard to convince the practical plant manager that there is any dust present; it also makes it impossible to tell, without the use of special instruments, whether the completed exhaust system is actually removing the dust.

It might seem like an insult to one's intelligence to say that after an exhaust system has once been installed it should be maintained in good operating condition. However, the numerous cases one encounters in the plants where this obvious necessity is not carried out, indicates that it is really one of the major considerations in connection with the elimination of dust or fumes. Cases are not unknown where the blower has in some manner become reversed so that the air is being ejected and diffusing the dust, rather than drawing it in; other instances where the efficiency of the system has been lowered or its value nullified by clogging up, disconnection or wearing out of the piping, etc., are all too common.

One concern, of which the writers have knowledge, has a "U" tube permanently installed in one of its main exhaust systems so that the foreman or safety man can tell at a glance whether there are any changes that would indicate a break-down in the system. All such installations should have regular inspections by some competent person as a routine part of their upkeep.

It will be sufficient here to discuss respiratory equipment very briefly. The simplest form of this equipment is the filter respirator. Such respirators have a definite value for temporary use such as sweeping up, cleaning out bins, shoveling materials, etc., but they require careful fitting and constant supervision to see that they are being properly used.

It is our opinion, after watching the sincere efforts in a number of plants to enforce the use of these respirators, that it is rather impracticable to require them to be used on full-time operation. One notices the men, under these conditions, surreptitiously pushing the respirator aside and gasping in free air like a fish out of water. Certainly, if they are to be used any considerable length of time, frequent rest periods should be allowed where the men can get out into the free air for a few minutes refreshment.

There are also the large air-fed helmets, with which most of us are familiar, used for sandblasting, etc., which have been carried to a high state of perfection for the purposes to which they are adapted.

We believe, however, that much more use could be made advantageously of the type of apparatus that lies midway between the filter respirator and the air-fed helmet, namely, the light, air-fed respirator which covers the nose and mouth and leaves the rest of the face exposed. With a light hose attachment, this device offers considerable freedom of movement, and if air outlets were supplied so the hose could be quickly transferred from one outlet to another it would seem to be practicable to use them over a considerable area. They afford the advantages of a pure air supply without excessive weight and without the restriction to breathing that is imposed by the filter respirator.

The Medical Supervision of Workers Exposed to Dust

By W. J. McCONNELL, M.D.

Assistant Medical Director, Metropolitan Life Insurance Co., New York City

The speaker said in part: The harmfulness of dusts varies widely in accordance with the physical and chemical natures of each individual substance. Certain dusts are soluble or slightly soluble in the body fluids and their harmful effects are proportional to the toxicity of the compounds formed. Lead, mercury, and arsenic are examples of poisonous dust. Other dusts exert their harmful effects locally on the skin and mucous membranes and through irritation to the respiratory passages. Chronic acid and alkalies are examples. Attention recently has been called to the probably harmful effect of dusts arising from radio-active ores. A fourth group of dusts which are insoluble or very difficultly soluble in the body fluids may initiate harmful pathological lung conditions. These may be subdivided into non-fibrosis and fibrosis producing dusts. The organic dusts, mainly the vegetable fibers, such as cotton, jute, hemp, etc., are non-fibrosis producing dusts. The fibrosis producing dusts are limited, so far as we have evidence, to a few of the inorganic mineral dusts, such as free silica, crystalline silicon, quartz, and certain combined silicates. *Of the fibrosis* producing dusts, those having a high percentage of free silica are admittedly the most important because exposure over a period of years to such dusts distinctly predisposes the individual to tuberculosis.

The effectiveness of dust control measures in preventing diseases produced by dusts can be determined only by careful physical examination of the workers so exposed under the guidance of competent medical supervision. The benefits which accrue to the employer and employee, alike, as a result of the physical examination of all applicants for employment, as well as periodical examination of those already engaged, would indicate very careful consideration by industry of a program for control of sickness. Such a procedure protects the employer from engaging an applicant already physically or mentally impaired who later may claim disability for a condition either not associated with employment or contracted during a previous employment. The applicant's physical and mental condition is established and by keeping record of his subsequent illnesses and accidents, the question of responsibility for injuries and sickness need never arise.

The applicant is protected from engaging in work for which he is physically ill adapted which, if undertaken, might easily bring about serious impairment of his health. For example, an applicant with an arrested tuberculosis who seeks work in a certain dusty occupation, if allowed to engage in such work might readily convert an inactive tuberculosis into an active one; thereby endangering life or at least seriously impairing the applicant's future efficiency and earning capacity. Whereas the same applicant if assigned to a position that involves no such exposure, might be expected to continue for years as a useful and productive workman. The examination of applicants for employment likewise protects those that are already employed from the risks of communicable diseases such as tuberculosis and various acute respiratory and other infections being introduced into their midst by a new applicant.

Many of the younger individuals who seek employment have never before received a thorough physical examination and consequently are unaware of the defects from which they suffer. As a result of physical examinations, many defects are located which may be removed or corrected before they have caused irreparable damage, thereby increasing the efficiency of the worker and often averting definite and finally chronic diseases. Furthermore, incipient tuberculosis, unsuspected diseases of the heart, kidneys, and a host of other diseases of a similar nature, are discovered and the applicant referred for proper medical care and treatment which otherwise might have been postponed until too late.

Of even more importance than the initial physical examination of applicants is the periodic examination and care of old employees by an industry. Such a procedure serves to check the efficiency of preventive measures designed to prevent occupational diseases. It offers the most effective way of controlling the health of

large groups of workers by discovering early not *only occupational diseases*, but many other conditions that go undiscovered until the worker is acutely ill or becomes disabled. If the various contagious conditions go unrecognized others become infected, thereby causing serious economic loss, as well as endangering the health of a group of individuals.

The information obtained from physical examinations affords the medical supervisor the opportunity to make certain that employees are engaged in suitable work out of which they are getting maximum results, to correct the effects of undue exposure to harmful environmental conditions, and generally to lessen all occupational hazards. As a public health measure, it is impossible to over-estimate the value of periodic examinations in establishing interest in sickness prevention.

The set-up of a proper program for medical control of workers exposed to dust depends upon the number of employees involved and individual plant conditions. A series of articles under the title of "The Medical Department Manual" by Dr. Hart E. Fisher, appearing in current numbers of "Industrial Medicine," gives a comprehensive account of the organization and operation of a medical department.

1. The establishment of a medical department with adequate facilities and medical personnel who have qualified in the field of industrial medicine. A process analysis of all operations in the plant should be made and the medical supervisor should list all possible health hazards and familiarize himself with their physiological effects. If necessary, he should conduct research studies to determine the harmful effects of new substances introduced into plant processes about which little is known. In cooperation with other departments, he should investigate the extent of the hazards and devise measures of control.

2. The routine examination of all applicants for employment. The procedure should include a detailed history of the applicant's previous illnesses and accidents classified under (a) diseases of childhood, (b) general infectious diseases, (c) respiratory diseases, (d) venereal diseases, and (e) accidents and resulting physical defects. A detailed history of previous occupations engaged in is very important. A mere statement of the type of industry in which the applicant was engaged has slight value, if any. The exact duties performed in each occupation should be noted and information ascertained as to the probable length of exposure to hazardous substances. After the history has been taken and a photograph for identification purposes (if part of routine) is made, the applicant should be directed to the examining room where he is instructed to remove his clothing for physical examination. This examination should be made as complete as is considered necessary to determine the applicant's physical condition.

If the applicant has been or will be exposed to dusts which induce lung diseases, an X-ray picture of the chest is an important part of the examination. This part of the examination may be referred to an experienced roentgenologist, as the value of this method of diagnosis depends upon the type of pictures taken and the experience of the reader who interprets them. The examining physician also may need additional information obtained by laboratory analyses of the blood, sputum, and the urine. These aids to diagnosis should be provided or made available when desirable.

3. The rating and placement of applicants. In cooperation with the personnel department, the applicant should be rated and placed, not only on his training and past experiences, but also on his physical and mental abilities to fill vacancies occurring from time to time. The record of his physical and mental examination should be the confidential property of the medical department.

4. Periodical physical examinations. The frequency of periodical examinations necessarily must depend upon individual circumstances according to the need for such examinations as determined by the supervising physician. Where physical examinations are made for the first time, the employees of long standing should be given ample explanation of the benefits of such examinations and be given assurances that their jobs are secure.

5. Provision for the disabled. Employees who develop disabilities during the course of employment should be re-assigned to occupations which will not interfere with or aggravate the disability, or they should be provided for in other ways.

ADJOURNMENT

Fire Prevention

THURSDAY AFTERNOON SESSION

October 4, 1934

The Fire Prevention Session convened in the Statler Hotel with Chairman Harold L. Miner, Manager, Safety and Fire Protection Division, E. I. duPont de Nemours & Co., Wilmington, Delaware, presiding. After briefly welcoming the delegates, Chairman Miner introduced the first speaker.

How Home Fires Are Caused

By R. B. CRISWELL

Ohio Inspection Bureau, Columbus, Ohio

Speaking extemporaneously, Mr. Criswell gave a demonstration of the devices employed and the arguments advanced by himself and other members of the Ohio Inspection Bureau in bringing to the attention of school children the serious hazards of flammable substances in the homes. His object was to inform safety engineers, and perhaps others in his audience who might be interested in becoming safety speakers, how to use simple devices in convincing the school children of the necessity for caution to avoid fires and explosions. Each device and method was outlined briefly, but with striking detail, some of the demonstrations being as follows:

A match, still blazing, was thrown carelessly into a small waste basket, as so many persons still continue to do, and the waste paper immediately flared into a dangerous blaze. With a short talk about the forest rangers and their watchfulness in putting out smoldering camp fires in the North Woods, he next carefully broke a match to make sure the match had gone out completely before he tossed it aside. Said he, "Chaperone your matches; they shouldn't go out alone."

A small doll house, wired in similar fashion to a comfortable home, was exhibited, and after an explanation outlining the many light and lamp fixtures, coupled with electrical devices, which might be loaded onto the electric circuit in any home, the speaker attached these devices one after another until the fuse blew out; then he used a copper penny to plug the circuit until a fire developed in the attic of the doll house.

Strangely enough, an ordinary fish bowl, with the goldfish swimming about, if exposed in a sunny nook of the living room, with a flimsy curtain in the right spot beside it, or even a flammable rug underneath, can cause a disastrous fire. The circular fish bowl and the water act as a lens to concentrate the sun's rays. This has happened repeatedly, said the speaker.

A pretty little doll, made of pyroxylin, or some other flammable material, has often become ignited in the hand of a child and has burned the child severely before

C. Hager & Sons Hinge Mfg. Co. (*Heavy Machine Shops Division—Group B*).
Chase Companies, Inc. Noera Mfg. Co. (*Heavy Machine Shops Division—Group B*).
Emsco Derrick & Equipment Co., D. & B. Pump & Supply Co. (*Heavy Machine Shops Division—Group B*).
Pittsburgh Steel Co., National Steel Fabric (*Heavy Machine Shops Division—Group B*).

"Your Hour"

The final feature of the program was the annual event entitled "Your Hour", led by T. H. McKenney, Supervisor of Labor & Safety, Illinois Steel Co., South Chicago, Ill. Mr. McKenney presented a number of questions in his characteristic manner, and a general discussion ensued which was participated in by all the delegates. The discussion was, of course, extemporaneous and no record of it is available.

ADJOURNMENT

TWENTY-THIRD ANNUAL SAFETY CONGRESS
NATIONAL SAFETY COUNCIL

Mining Section

Officers 1933-34

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H. C. Henrie, Phelps Dodge Corp., Bisbee, Ariz.
Thomas E. Lightfoot, Koppers Coal Co., Pittsburgh, Pa.
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George Martinson, Pickands, Mather & Co., Hibbing, Minn.
D. D. Moffatt, Utah Copper Co., Salt Lake City, Utah.
M. W. Price, Jeddo-Highland Coal Co., Jeddo, Pa.
L. T. Sicka, St. Joseph Lead Co., Bonne Terre, Mo.
Howard I. Young, American Zinc, Lead & Smelting Co., St. Louis, Mo.

experienced, have proved most successful. Posters from the National Safety Council are also extensively used.

However, bulletin boards may lose a great portion of their effectiveness, in spite of regular changes of materials. We felt that a new method should be tried, and the moving picture with sound reproductions was adopted. We now have four or five underground theatres, equipped with permanent benches, a ten foot screen, and electric lights. Notices of scheduled shows, which are held before the men start their shifts, are posted a day or two in advance, and as the men enter the mine they are greeted with music amplified from phonograph records placed on an ordinary turn-table equipped with an electric pick-up. Lively marches and popular pieces are played as the men gather at the theatre.

The first film is usually a comedy which makes for a feeling of good fellowship and creates in the group a responsive mood for the discussion of safety, health, or other similar subjects. To illustrate or clarify some accident, stereopticon slides are extensively used. Following the safety reel, a second comedy or educational film that might fit in is usually given. The entire program takes about 35 to 40 minutes. It has been noted that all employees, whether engaged in underground or surface work, make every effort to be present at these shows.

Through this method of publicity and education by sound movies, it has been a great deal easier to sell the idea to the men of the desirability not only of individual personal safety, but also the necessary cooperative spirit for a well rounded program of watching out for the safety of fellow workers. All of our underground men now use safety hats and shoes, and our statistics show that since the adoption of these two devices, many accidents to the head and feet have been eliminated entirely and others greatly reduced in severity.

Having once obtained the cooperation and confidence of the employees, many suggestions for making operations more safe have been volunteered by the men. Accidents on the haulage lines at one time occurred in frequent numbers, but one by one they have been eliminated, as have the serious accidents caused by falling rock. A great part of the credit is due to the individual employee; but do not forget that results would not have been obtainable if management had not awakened his interest and his desire to have for himself and his associates a safe place to work.

That our Missouri safety program is successful from a money point of view is shown by the total costs, including the Safety Department expense, of $2.39 per $100 of payroll, and it is believed that from a human point of view we also have a right to be very pleased, as the comparative numbers of lost-time accidents and deaths prove. In 1928 we had 320 lost-time accidents and five deaths; in 1929, 438 lost-time accidents and no deaths; in 1930, 304 lost-time accidents and two deaths; in 1931, 174 lost-time accidents and two deaths; in 1932, 123 lost-time accidents and one death; and in 1933, 70 lost-time accidents and no deaths.

In many small cities and towns throughout the United States, one of the large American companies may be the sole employer, and if so is usually the principal taxpayer. When such conditions exist, it is just as important to consider the safety of the community as it is to improve the safety of the individual employee. The management, therefore, must take an active interest in the general welfare of the locality. In the lead belt of Missouri the St. Joseph Lead Company is the principal employer, and in order that the communities in which the men and their families live might have the benefit of pure water, it has constructed an extensive system whereby the chlorinated mine water is delivered to the house and stores. The company has also built a dairy or pasteurizing plant, for the purpose of supplying a sufficient quantity of pure milk for the people, especially for the children. 63 per cent of the local real estate and property taxes have been used for building and maintaining schools, and in this way the primary and secondary schools in the lead belt have been developed until they are today among the best in Missouri.

With the assistance of the company, a local health unit was organized on July 1, 1922, in order to demonstrate the efficiency and economy of adequate health service for the prevention of disease and the promotion of public health. The group life insurance plan that was adopted by the company and given to its employees in 1919, and the formation of a definite pension program in 1914, have also proved valuable aids in the safety program, as they have aided in reducing the labor turnover.

It is also to be realized that a safety program or method that is suitable for one company or location may not be desirable for another company. For example in our two New York state mines, which have the same regulations regarding safety hats, shoes, goggles, etc., and where the primary rule is also enforced that each and every man is responsible for his own safety and for the safety of his fellow worker, great emphasis is placed on housekeeping or cleanliness about the mines and mills. Each department of the two divisions has a metal sign, ruled in three columns; one being for the month of the year, while the other two are for the housekeeping rating and lost-time accidents. If the conditions are good, a gold star is placed on the sign; if only fair a green star is awarded, while for poor cleanliness a red star is given. A gold star counts ten, a green five, and no score is given for red. These scores are posted monthly on the bulletin board, and the basis of comparison between the two mines is thereby made possible. If a score is not perfect, or at a reasonably high figure, the department which is negligent receives considerable adverse publicity. If there are no lost-time accidents, a gold star is placed in the accident column.

The results of our New York safety program are reflected by the achievement of operating 162,912 man-hours with only one lost-time accident (which incapacitated a worker for two days), and this record resulted in the 1932 award of the "Sentinels of Safety Trophy."

THURSDAY MORNING SESSION

October 4, 1934

The Dust Problem in Mining Operations

By D. E. CUMMINGS

Assistant Director, The Saranac Laboratory for the Study of Tuberculosis, Michigamme, Michigan

The speaker said in part: Refuge can no longer be taken under the shelter of ignorance that the prolonged inhalation of dust may lead to serious disease, for the medical, technical and lay press is filled with accounts describing the dangers associated with breathing certain dusty atmospheres. What, then, should be the proper course to pursue in meeting this problem and dealing with it in a satisfactory manner?

Both industrial and laboratory studies prove that only certain dusts are dangerous when inhaled, and that quartz or other forms of pure crystalline silica are most dangerous, constituting a specific tissue poison. Where men are exposed to a sufficient quantity of very fine pure crystalline silica dust only, a true hazard always exists. The dusts of silica in combination with other elements generally give rise to pulmonary reactions which differ in many respects from those caused by pure silica, and which vary rather widely among themselves in their harmfulness. As a class, and with the notable exception of asbestos, silicates are less dangerous than pure crystalline silica. Not only are certain dusts apparently incapable of producing a specific harmful reaction when inhaled by themselves, but when associated with silica favorably modify the usual response to this dangerous dust. The effective size range of particles causing disease is now regarded as three microns and smaller, while the qualities of hardness and sharpness are no longer regarded as of significance. The term pneumonokoniosis is intended to describe the changes arising out of the prolonged inhalation of any dust, harmful or otherwise, and does not necessarily imply the presence of disability, nor a predisposition to pulmonary infections. The term silicosis refers specifically to the disease which results from the prolonged inhalation of harmful silica dust, and is characterized by a generalized nodular fibrosis in the lungs and pulmonary lymph nodes, and increased susceptibility to pulmonary infections. Pure silicosis should be regarded as a geniune occupa-

tional condition, but it should also be understood that uncomplicated silicosis is seldom disabling to any significant degree. Disability usually results from pulmonary infections, generally tuberculous, which the silicotic contracts or reactivates more readily, and handles less successfully than the normal person.

Every effort should be made to prevent silicotics from contracting infections which will later prove disabling, and to protect those who have pulmonary infections from being dangerously exposed to harmful dusts. In order to determine which workmen in a hazardous industry have silicosis or pulmonary infections, all employees should have a thorough physical examination including the taking of a complete occupational history and satisfactory stereoscopic roentgenograms of the chest.

Since the rate at which silicosis develops depends upon individual susceptibility and the degree of exposure, it follows that these factors should be determined as accurately as possible. Individual susceptibility to a dust hazard can be estimated fairly accurately from a single examination, and can be defined quite exactly by repeating these examinations at regular intervals. The degree of exposure for each individual should be evaluated by determining the length of service, and the concentration, size distribution, and composition of the dust suspended in each working place during each operation. The method generally used to enumerate dust particles is that accepted as standard practice by the U. S. P. H. S. with the addition of dark field illumination as suggested by Fehnel and Cummings. Size distribution studies can be made by any of the several satisfactory techniques. The composition of the dust can be studied by the usual quantitative analysis, supplemented by petrographic and rational chemical analysis to determine the amounts of free and combined silica and the other minerals.

A medical and technical survey should be supplemented by an analysis of the mortality records in and about the locality under study, and by the information obtained from carefully performed post-mortem examinations on employees who have been exposed in the industry and who have died from any cause. If these procedures for recognizing and defining a hazard are carried out under the supervision of an organization competent to deal with the many complex and confusing aspects of the problem, the investigation will be worth while regardless of the conditions which are discovered. Where the findings of such a study fail to disclose a significant hazard, both the employer and employees will gain the protection which this knowledge affords; and if a health hazard is discovered, the original investigation will serve as a guide to the program which should be inaugurated to overcome the dangers disclosed.

The most severe dust hazards in mines or in plants can be reduced as successfully as were accidents by the Safety First program, and the chief requisite to success lies in establishing adequate control procedures. The physical condition of all the employees must be determined at regular intervals, and well interpreted roentgenograms provide a most satisfactory control procedure. Men applying for work should not be hired until they have passed a thorough physical examination, including chest roentgenograms. Reliable records should be established to show the exact time, place and duration of employment for each person working in hazardous positions. Policies of employment should be worked out for each mine or plant, based upon an accurate knowledge of the physical condition of each employee, so that all of the workmen may be protected from contracting occupational disabilities. Occupations should be selected which are compatible with the physical condition of the employee. Care should be taken to protect the silicotic from infection, or the case of infection from harmful exposure to silica, or the normal individual from contracting either silicosis or pulmonary infections.

Engineers should be especially trained to recognize and deal with dust hazards in mines or plants, and it should become accepted practice, where a hazard exists, to maintain a constant check on the amount of dust present in the working atmosphere. The method of dust counting accepted as standard by the U. S. P. H. S. should be adopted by all industries having a hazard, not only to determine the amount of dust in the air, but more particularly to maintain a control over the effectiveness of the procedures adopted to reduce the dust. Records should be kept which will disclose the amount of dust present in each working place, and the preventive measures which are in use.

Shortly after the inauguration of a program designed to control a known dust hazard, it will become evident that marked improvements can be effected without incurring an impractical expenditure. Personnel problems will arise, due to the reluctance of labor to accept new procedures, and in the end, these problems must be dealt with by educating workmen to recognize the necessity for introducing methods to control dust hazards. The question of what men should be told regarding their physical examinations should follow the practice adopted by any reputable physician in dealing with individual cases. As industry becomes more familiar with this problem, it will discover the serious need for further research.

Since silicosis is a true occupational disease, disability resulting from or attributable to it should be compensable in the same manner as other injuries sustained as the result of employment. Only the intelligent cooperation of industry will bring about the formulation of reasonable occupational disease legislation and its fair administration.

Silicosis from the Operators' Standpoint

By G. C. BATEMAN

Secretary, Ontario Mining Association, Toronto, Ont., Canada

The speaker said in part: It is important to know what causes silicosis, but unless a knowledge of the cause leads to a cure, it is not nearly as important from the operators' viewpoint as the knowledge of how to reduce the incidence. With all the research work that has been going on throughout the world for many years, we still do not know the cause and we still have no cure, but we have learned a lot about how to reduce the incidence.

The silicosis provisions of the Ontario Mines Act and the Compensation Act were passed in 1926. These provided for the examination of all men employed in positions in mines where they were exposed to silica dust, for all such workers to be the holders of medical certificates certifying as to freedom from tuberculosis of the respiratory organs, and also for compensation to men affected by silicosis.

This legislation was introduced as a result of a survey in Northern Ontario mining camps which indicated that silicosis had made alarming progress among the miners. There being no reason at that time to question the results of this survey, the operators agreed to do all that was asked of them and cooperated fully with the Government in the steps considered necessary to meet the situation.

When this legislation was first introduced in Ontario, we were advised that men with a moderate degree of silicosis, while not physically disabled, were better out of the industry and that they should be paid a lump sum which would assist them in rehabilitating themselves in some other occupation.

We were further advised that if we took active steps to clean up the situation then existing, pension the more serious cases and remove men in the early stages of silicosis from underground, the situation would be well in hand, the first expense would be the heaviest, and that from then our liability would be practically limited to the anteprimary cases as they developed.

When the 1926 Amendments were approved by the mines it was our understanding that men in the anteprimary stage had suffered no impairment of working capacity and that the $500 payment was a compassionate allowance for rehabilitation and not for disability. We further understood that with the payment of $500 to these men our responsibility in respect to them would be practically ended. It developed, however, that the legal position was different. The Compensation Board cannot make an award except for disability and where disability has once been established the claimant can come back for review on evidence of further disability. It is generally accepted that silicosis predisposes a man to tuberculosis. It followed, therefore, that with secondary silicosis as defined in the Act, if any anteprimary silicotic at any future time and from any cause whatsoever developed tuberculosis, his condition was considered to be the result of his original disability and he was entitled to total disability compensation at an average cost of $12,000 per case.

When, therefore, an award of $500 was made the Compensation Board immediately set up a prospective reserve for progression of an additional $11,500, with the result that we had an estimated liability to the end of 1932 of several million dollars, most of which was outstanding.

With the passage of time it also became apparent that the removal of the men from underground employment in the early stages of silicosis did not have the results anticipated. The payment of a lump sum award did not in most cases serve the end expected. As a general rule this money was expended for other things and the men made little effort to rehabilitate themselves. A certain number of men classified as silicotic continued in their underground employment and we found practically no difference in the rate of progression in those who continued as compared with those who were taken out of the mines. Some of this may have been due to the altered economic status, but even if the economic status had remained the same, we were forced to the conclusion that there was little if any benefit to the men by removing them from underground work, unless of course, there was evidence of an onset of tuberculosis.

It should, of course, be understood that during this time active efforts were made by the mines to improve ventilation and to allay dust. Without this the above statement would not hold true. Steps were also taken by the mines to provide that men in the early stages of silicosis were placed where the conditions underground were most favorable.

Our experience also indicated that the early stages of silicosis do not necessarily mean an impairment of working capacity. This is all the more important on account of the difficulty of diagnosing silicosis in its early stages, as there is no sharp line of demarcation between the pre-anteprimary and the anteprimary, or between anteprimary and primary stages, and as a matter of fact, we believe that there is a great deal more uncertainty in the diagnosis of silicosis than the medical men are willing to admit. The determination is largely a matter of personal judgment and therefore subject to error.

A great deal of what may be read into an X-ray film depends upon the technique in taking the film. Certain other diseases and chest conditions will also give in the film an appearance simulating that of silicosis and we believe it is safe to say that without a definite knowledge of occupational history the diagnosis of silicosis in its earlier stages would be practically impossible.

In view of these conditions, it was felt that the industry was carrying an unfair burden and in 1933 the Act was amended. The anteprimary and primary classifications were deleted, compensation was made payable only for disability, which means actual impairment of working capacity, men with a moderate degree of silicosis were allowed to continue underground work and the industry was relieved from unlimited liability in respect to progression by providing that the claimant must make and establish his claim for disability within two years of leaving the employment at which he was exposed to dust, to entitle him to compensation.

As I said before, silicosis is essentially an employer's problem. It is in many places an important item in his cost of production and to a considerable degree it is a controllable item of expense. If the employer simply leaves the matter in the hands of the doctors, he will have no one to blame but himself over what it costs him. The opinion of the ordinary practitioner and even of the roentgenologist and expert chest and lung man may be of little value. Only the opinion of those doctors who have had special training in the diagnosis of silicosis from both clinical and X-ray examinations should be accepted, and even those opinions cannot be accepted in all cases.

We do not say this with any intention of criticizing the members of the medical profession, but where the matter is so important and costly to industry, where so little is actually known about the disease, and where there is still an element of uncertainty in the diagnosis of silicosis in its earlier stages, too much care cannot be exercised, and the closest scrutiny by industry which has to pay the bills is most necessary. The best results can only be obtained by the employers and the doctors working together, but the employer must consider it as one of his particular problems.

I have also stated that in the absence of any cure it is much more important to know how to reduce the incidence than to know the cause. We believe the chief preventive measures are as follows:

1. Improvement in fundamental working conditions in the matter of ventilation and allaying dust.
2. A rigid initial examination to keep out of the industry those men whose physical condition would indicate a type most susceptible to silicosis and tuberculosis.
3. Control of tuberculosis not only among employees, but also among those with whom they come in contact.

It goes without saying that if silicosis is caused by the inhalation of dust, the removal of dust will remove the cause. This means ventilation and lots of it, and where possible the wetting down of dusty places. In mining operations the chief source of dust is believed to be from blasting, therefore the time interval before men return to a blasted face is important.

Ventilation and water will remove the visible dust from the air, but it is not the visible dust that causes the damage. It is the dust that ranges between one-half and five microns that is dangerous and is so difficult to remove, and the quantity in the air can only be determined by some method of sampling.

We would consider it a mistake to have either the type of sampling apparatus or the permissible dust count defined by law. This may be all right on the Rand in South Africa where conditions are more or less standard, but it is not advisable in the United States or Canada, where conditions vary so greatly. For one thing, we do not know what constitutes harmful dust and there is no standard practice for the treatment of dust sample slides. The untreated side of a sample taken near a carbide lamp in an otherwise dust-free atmosphere, would show an apparent very high dust count. Dust sampling, however, should be a part of the regular routine, using the type of apparatus best suited to the particular conditions, and this will show whether the atmosphere is good, fair or poor.

Next to ventilation and the laying of dust, the most important measure is to carefully select the type of men to be allowed to work in the industry. This requires a rigid initial examination which should include a complete physical examination and X-ray. By this means men with the type of chest which would indicate their susceptibility to tuberculosis and silicosis can be eliminated. The complete physical examination should also have a beneficial effect on the accident rate.

Uncomplicated silicosis is not a big problem, but silicosis and tuberculosis combined represent a very real problem. The measures for the control of tuberculosis are well known. Particular care should be taken that men with tuberculosis be withdrawn from the industry and given proper care and treatment. Places where the employees live should also be supervised to see that they are not exposed to tubercular contacts.

Some Aspects of the Silicosis Problem

By DR. H. H. MOORE and DR. M. J. KELLY

Medical Staff, Hollinger Consolidated Gold Mines, Ltd., Timmins, Ontario, Canada

The speaker said in part: In 1928 the Ontario Mining Act was amended to provide physical examination on employment and yearly thereafter, or twice yearly if indicated, of all underground men. To be employed the workman must hold an official certificate good for twelve months, stating that he is free from disease of the resniratory organs. This certificate must be renewed at each annual examination. In the meantime, an amendment to the Workmen's Compensation Act provided for the appointment of medical officers working under the supervision of the Compensation Board to conduct these examinations. Cases of silicosis arising at these examinations are submitted to the Workmen's Compensation Board if the total exposure to silica of five years in Ontario mines is verified. In addition to this routine with silicotics, there is a close check kept on the possible undue progress in the fibrosis in any case and if necessary steps are taken to remove such a case from harmful contact with silica.

The act in its present form was passed in 1933 and served to clear the situation which had become involved by the tie-up of large sums of money in reserve funds against possible future claims by men adjudged silicotic previously, but who had since been lost sight of or who were carrying on at work showing a minimum or no disability.

From the workman's point of view, the new act is a great step forward, as it allows a man to continue at his usual duties underground as long as he is able to work without any serious degree of discomfort. Previously, a workman was advised to quit underground work when a certain stage of fibrosis had been reached, regardless of his ability to carry on, and sacrificed his rights to compensation if he continued to work.

In the X-ray examination of the chests of the 2007 men employed at the Hollinger mines during 1933, determinations are graded as follows: *Normal* is a chest showing little or no fibrosis, where the condition of the lung is better than the average for the age. *M. F.* or "More Fibrosis" is a chest which is normally found in the average adult at the age of the miner under consideration. *M. F. P.*, "More Fibrosis Plus" is a chest showing slightly more fibrosis than normal for the particular age. *M. F. P. P.* or "More Fibrosis Plus Plus" is a chest showing considerably more fibrosis than normal and is a pre-silicotic stage. Silicotics are that group which show a great deal of fibrosis and taking into consideration the mining history and consequent exposure to silica, are thus termed. Admittedly, disability may or may not be present. This last group ranges from the early silicotics with a minimum of disability to the late complicated or secondary cases with marked disability and tuberculosis. It must be added that a large number of men at the commencement of employment at the Hollinger, and without previous mining experience or contact with silica, show chests of M. P. P. rating. Following are the results of this examination:

Normal	33	1.4%
M. F.	920	40.8%
M. F. P.	932	41.4%
M. F. P. P.	98	4.3%
Silicotics	24	1.1%

Average contact with silica of men working and M. F. P. P. ..... 12 years.
Silicotic ..... 15 years.

Next is an analysis of the changes in chest rating in 1933.

Normal	to M. F.	11	
Normal	to M. F. P.	3	
M. F.	to M. F. P.	207	
M. F. P.	to M. F. P. P.	9	
M. F. P. P.	to T. B.	1	
M. F. P. P.	to A. P.		
A. P.	to P.	231	
M. F.	to Normal	11	
M. F. P.	to M. F.	231	
M. F. P. P.	to M. F.	1	
M. F. P. P.	to M. F. P.	20	
T. B. ?	to M. F.	1	
T. B. ?	to M. F. P.	1	
A. P.	to M. F. P. P.	1	
P.	to A. P.	266	Total 497

These figures cover approximately 500 men in whom there was some change in chest rating during the year, and the direction of the change. The remaining 1500 men show no change from the previous year. It will be observed that 231 men showed an increase in fibrosis rating, while 266 show chests which are improved. The explanation given for the group which shows improvement is, in the first place, that some concurrent bronchial or upper respiratory infection had complicated the picture at the previous annual examination and so caused a more advanced rating to be given. The second explanation is that constant improvement in radiological technic is making diagnosis more accurate.

It would seem, therefore, that on the whole the situation is showing considerable improvement from this viewpoint. During 1933 no case progressed from the pre-silicotic to the silicotic stage. In the years up to 1933, 120 men had been rated silicotic and the total cost to the Hollinger involved a sum of $915,950, which figure includes the progressive and contingent funds set aside to cover future costs and possible future claims.

Two objects have been kept in mind during the many years of study of the dust problem at the Hollinger Mine.

1. The collection of complete data regarding the nature of air breathed by workmen in different occupations, its chemical composition, temperature, humidity, dust content and rate of flow.

2. Working tests of all practical methods of improving the condition of such air.

In searching to adapt a method for the determination of air dustiness, it was realized that no instrument has been devised which would measure the dust content of the air with scientific precision. Furthermore, it was felt that the principal object of making determinations was to ascertain if the dust count of the air was undesirably high, and if such a condition was found, to devise a method of reducing it. Hence, for practical purposes, the instrument which possesses a high efficiency in the range of desirable concentrations and gives a quick indication of dangerous quantities of dust is most desirable. The circular Konimeter, invented by Sir Robert Kotze and introduced to the Miners' Phthisis Prevention Committee of South Africa in 1916, has therefore been used in the Porcupine District for the past eight years.

A summary of our investigations along this line may be given as follows:

1. About 900 of the underground force are engaged in work which will produce dangerous dust if measures of control are not applied.

2. Of this number a little over 400 are engaged in shoveling broken ore into cars and the average dust exposure does not exceed 300 particles if the muck piles are kept thoroughly wet and blasting carefully restricted.

3. The remaining 500 men are engaged in drilling and blasting operations and are subjected to severe potential hazard. Men engaged in stopes who do not have to return to the working faces have an average exposure of about 1200 particles, while using the ordinary type drills. It is felt that the use of the "dustless" type of drifter will reduce the concentration of dust to somewhere near 300 particles.

4. The men engaged in development drifts are exposed to the same concentrations of dust, namely, 1200 particles. Where possible, two development drifts are worked simultaneously by the one crew, so that the men do not have to go back through the dense dust after blasting the cut. There are only a few exceptions to this rule and when necessary to go back to load the remaining holes, the men are provided with the special respirator.

5. The high dust concentrations in the vicinity of stopers we hope to deal with by the use of compressed air masks. Also the practice of driving adjacent raises simultaneously has reduced the hazard after blasting.

With the constant improvement and maintenance of general health conditions kept always to the fore as most desirable and necessary in aiding in the solution of the silicosis problem, the men at the Hollinger Mine are cared for under a contract medical system. The facilities and service at mine, office and hospital are most complete and efficient and in combination with the annual or semi-annual check made by the medical staff of the Compensation Board, health of the workers is under constant supervision.

Men who report with such conditions as non-tuberculous or non-silicotic chest trouble, with focal infection in teeth, tonsils, sinuses, etc., are singled out and treated and observed and where necessary changes in occupation are made or rest and vacation periods advised.

At the mine, constant improvements have been made and at present the following is the routine. A worker coming off shift removes all his mining clothing, usually wet, and racks them on a set of hooks attached to a chain and pulley. These wet clothes are pulled up to a height of 15 to 20 feet and hang thus in a hot, dry

atmosphere for 14 to 15 hours, during which they are thoroughly dried. After undressing the miner passes through a series of shower baths of temperatures varying from hot to cold. After drying he proceeds to his locker where he has placed his street clothes before the beginning of the shift.

With a view to reducing the infection of silicotics with tuberculosis, a clinic has been established in Timmins. An experienced public health nurse is employed full time and it is her duty to visit all tuberculosis suspects and patients, all contacts with these cases and contacts with silicotics to arrange for their examination and supervision and if necessary for treatment. Weekly clinics are held at which such patients are examined clinically, radiologically and by bacteriological and biological tests.

Since January of 1933, approximately 30 dangerous cases of tuberculosis have been removed from the district to a sanitarium and many more less severe cases placed on bed rest at home or on restricted activity. It is felt that by removing these cases from contact with silicotics, that within a comparatively short time tuberculosis will be moderately well controlled and since tuberculous infection is necessary to precipitate secondary silicosis, this movement, it will be appreciated, is an excellent one.

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The Dust Hazards in Industry

By DR. R. R. SAYERS

Medical Officer in Charge, Office of Industrial Hygiene and Sanitation, United States Public Health Service, Washington, D. C.

The speaker said in part: Realizing the importance of the dust problem in industry, the United States Public Health Service in cooperation with the Bureau of Mines began its first study of the health of workers in dusty trades in 1914, in the mines of Joplin, Missouri; and later, in 1923, the Public Health Service inaugurated a series of dust studies. These later studies were all conducted in the same manner in order to permit as detailed a comparison as possible between the different investigations.

Briefly, these methods of study may be divided as follows: (1) examination to determine the general physical condition of the workers under observation; (2) special physical examination to determine the prevalence of specific diseases of the respiratory system and the lung pathology resulting from exposure to the particular dust hazard; (3) record of the nature and severity of the disabling illnesses; (4) analysis and detailed study of the occupational environment; (5) occupational mortality statistics relating to the specific dust; and (6) autopsies.

The first six intensive investigations carried out by the Service dealt with the health of workers exposed to dusts in a cement plant, granite cutting industry, anthracite and bituminous coal mining, silverware manufacturing plant, cotton cloth manufacturing, and in municipal street sweeping. Brief studies were later conducted in certain slate, granite, marble and talc quarries, while more recently a rather extensive study of the health of anthracite coal miners was completed.

These six dust studies showed that the workers in the granite cutting plants who were exposed to the highest dust concentrations were found to suffer from an excess of pulmonary tuberculosis after 15 years or more of exposure and developed silicosis from 2 to 10 years. In the group exposed to a lesser amount of dust, silicosis developed only after prolonged exposure, with no excess of tuberculosis. It was found that a close relationship existed between the degree of dust exposure and the extent and severity of the pulmonary damage. Anthracite coal miners suffered from dyspnoea and other signs of pneumoconiosis and experienced a high rate of respiratory sickness; in addition, an excessive mortality from influenza-pneumonia and possibly tuberculosis was found. Bituminous coal miners experienced a generalized fibrosis of the lungs and an excess mortality from influenza and pneumonia. Cement workers showed some signs of early pneumoconiosis with an excess of diseases of the upper respiratory tract. On the other hand, workers in the cotton cloth and silverware manufacturing plants and municipal street sweepers were negative for respiratory conditions and other illnesses when compared with the general industrial population.

Rock Drilling. For five years, the United States Bureau of Mines studied lead and zinc miners in the Tri-State District, Oklahoma. The ore here is high in free silica. Of the 7,722 men examined, a group of 1,647, or 21.3 per cent, was definitely diagnosed as having silicosis, not including those diagnosed as having tuberculosis. All the men diagnosed as having first-stage silicosis had worked an average of 13 years, but those men starting in the mines after 40 years of age worked an average of only 8 years.

The work of rock drilling in subway and tunnel construction in New York City is in some respects similar to that of some of the activities in the hard rock mines, at least in so far as the manner in which dust is evolved, the type of dust and the resultant hazard. Recently the result of a study of rock drillers, blasters and excavators was reported by the New York Tuberculosis and Health Association. An examination of 208 rock drillers, blasters and excavators showed that 118, or 57 per cent of the men had silicosis in various stages of progression. The exposure of most of these men (75 per cent) had been for 20 years or more.

Sandblasting. No study of the health of sandblasters has been reported in the United States; however, a study of the dust exposure of sandblasters was recently completed by the United States Public Health Service in cooperation with the

National Safety Council. This investigation indicated that, judged by the nature of the dust and degree of the exposure, a real hazard exists in this occupation. This study also brought out the fact that it is possible to conduct sandblasting with safety, provided properly designed and well maintained equipment is used.

Diatomaceous Silica Workers. Most of the data on silicosis have been gathered from studies made both in industry and experimentally on dusts containing free silica in the form of quartz. Such studies have been made in the granite industry, pottery trades, hard rock drilling, etc. There are other free silica minerals in existence that are not crystalline in nature but of an amorphous composition. In Santa Barbara County, California, there exists the largest and purest diatomaceous silica deposit in the world. This substance consists of about 85 per cent free silica. Recently an examination was made of 108 workers selected among those employed less than 1 year, 1 to 2 years, 2 to 5 years, and more than 5 years. All of the workers were Mexican laborers and the examinations consisted of x-ray determinations, social and medical histories, and clinical examinations of the chests. Dust determinations were also made but these were not reported. The outstanding feature revealed by the examination was the splendid physical condition of the men. Eighty-four per cent of the workers were reported in excellent physical condition. It was found that 60 men showed signs of early pneumoconiosis; 15 were in the moderately advanced stage and 6 in the advanced stage. This latter finding was among workers with a history of exposure of more than 5 years.

Dust Hazard in the Granite Quarry Industry. It is a common belief that granite quarrying is not so dangerous an industry as granite cutting in enclosed sheds; quarry work is done outdoors and hence may not be attended with very much dust exposure. However, certain quarry operations require the use of pneumatic tools, which are usually associated with the formation of considerable quantities of dust. It was thought that a study made in a representative granite quarry might cast some light on our problem. Accordingly, a study of a clinico-radiographic nature of 63 quarriers was made and occupational dust exposures were also obtained. The dust determinations show that nearly 38 per cent of the workers (drillers) were exposed to many times the amount of dust considered safe at the present time. Drillers were the only persons showing pathologic lung changes. Half of these workers with an exposure of 5 to 19 years had silicosis, and 4 of the 5 men with more than 20 years of such trade life showed this condition. This study suggests that quarry drillers may experience as high a death rate from pulmonary tuberculosis as do pneumatic-tool workers in granite cutting sheds.

Effect of Inhaled Marble Dust. The pulmonary fibrotic changes due to the inhalation of marble dust appear to be slight in comparison with those caused by stone dust containing a high percentage of silica in the form of quartz. A recent study made by us among marble workers showed that although marble dust, when inhaled in concentrations averaging about 25 million particles per cubic foot of air, produced a mild bilateral, linear fibrosis in a certain number of the 80 men examined, no serious lung changes were noted and there was no disability due to the dust, even after many years of exposure (more than 40 years in some cases). The marble dust under consideration consisted of 98 per cent calcite and 2 per cent dolomite, with no silica present.

Dust Hazard in Abrasive Industry. Artificial abrasives are widely used in industry and for this reason the effect of the inhalation of dusts produced in the manufacture or preparation of these products is of great importance. In 1925, 1929 and again in 1931, Dr. Clark of the Norton Company at Worcester, Mass., made investigations of workers exposed to aluminium oxide and silicon carbide dust produced in the manufacture of grinding wheels, which showed that during a period of 13 years there were proportionately twice as many cases of pulmonary tuberculosis among those working in the abrasive dust departments as in departments where no abrasive dust occurred. In 1931, Kessler, of New Jersey, reported the occurrence of over 100 cases of alleged silicosis in the abrasive powder industry, in which the dust consisted of 99 per cent free silica.

Exposure to Silicate Dust. It has been the belief that the inhalation of dusts composed of silicates (combined silica), in comparison with silica (free silica in the form of quartz), was innocuous. Of recent years many investigators have become cognizant of the hazards of silicate dust exposure. Asbestosis, a fibrosis

of the lungs caused by the inhalation of asbestos dust, has already been described both in its clinical and roentgenographic manifestations by investigators in other countries, but to date no studies have been reported in the United States. Cement dust, which contains about 22 per cent combined silica, has been studied, and the effects of the inhalation by workers has been discussed here. In March, 1933, Dreessen, of the United States Public Health Service, reported the results of a study conducted among tremolite talc and slate workers. The slate dust to which these workers were exposed consisted mainly of silicates, there being less than 3 per cent of quartz in the dust. The talc was a hydrous calcium-magnesium silicate, being 45 per cent talc and 45 per cent tremolite, with no quartz present. The results of the study seemed to indicate a relationship between the amount of dust inhaled and the effect of this dust on the lungs of workers.

Statistical Studies. Recently, Lanza and Vane estimated that there are some 500,000 workers engaged in the mining, quarrying and manufacturing industries in this country in which an exposure to silica dust to a harmful degree is entailed. Their analysis of mortality experience of twelve life insurance companies for the period 1915-1926 showed that the actual mortality from respiratory tuberculosis among the silica exposed persons was about three times that of a non-silica dust group. If one considers their data for certain occupations in metal mines and granite and sandstone quarries, occupations known to be exposed to high concentrations of hazardous dusts, then the comparison is more striking, since the actual deaths among these workers was found to be ten times that of the expected deaths. More detailed statistics on occupational mortality as reported by the Registrar-General of England and Wales (1921-1923), and summarized by Britten, show the high rate of 1,886 per 100,000 for tin and copper miners, while the rate for "all occupied and retired males" was only 150. Other occupations with silica exposure showed an excess.

From the evidence just presented concerning the injurious effects produced by the inhalation of certain dusts, it is apparent that a knowledge of the properties of a given dust which determine its capacity to produce pulmonary pathology is essential. Numerous investigations of the industrial dust problem indicate that these properties are the chemical and mineralogical composition of the dust, its concentration in the industrial atmosphere, and its particle size.

In an earlier portion of this discussion evidence was presented which indicated that a close relation existed between morbidity and mortality rates from various respiratory diseases and the exposure to certain dusts in industry. In the study of the dust hazard in the granite cutting industry, it was definitely proved that there is a direct relation between the magnitude of the dust exposure and sickness and death resulting from tuberculosis. It is quite evident, as a result of these studies, that *the remedy of the dust evil lies in the effective removal or suppression* of the dust to concentration considered safe. However, no set rules may be established for the mechanical protection to be instituted in an attempt to control industrial dust. Specific conditions encountered in a plant will determine the type of protection to be employed.

The protection of workers against certain dusts known to be toxic may at times be accomplished by the substitution of a non-toxic material for the toxic one. One example of such a procedure is the possible use of a metallic or other type of artificial abrasive for sand in the sandblasting process in those operations in which it is not essential to use sand, a substance high in quartz content. Again, the mechanical enclosure of the dust-creating process also serves to protect the worker. An excellent illustration of this type of protection is afforded by the modern sandblast barrel used in the cleaning of small objects. Sometimes it is possible to protect the worker by the substitution of wet for dry processes, as wet drilling instead of dry. In one instance, in the granite cutting study previously mentioned, an operator using a diamond point tool worked the stone wet; the resulting dust amounted to 22 million particles per cubic foot. The same operator was then requested to work the stone dry; as a result, the amount of dust reached the high figure of 45 million particles per cubic foot. In the weaving of asbestos cloth it has been possible to reduce the amount of dust in the air by wet weaving to one-fourth of the amount present when the process is conducted by dry methods. *Another example of this procedure in allaying dust is the use of a spray of water* in keyner and jack-hammer drilling in hard rock, although the new type of Kelly dust trap is now finding much favor for this kind of work.

The Kelly trap consists of a metal chamber designed to enclose the drill steel at the rock surface. No attempt is made to secure a mechanical seal with the rock or between the trap and the drill steel. The dust is removed by an air stream and is carried into an exhaust system connected to the trap. Escape of dust particles through openings between the uneven rock surfaces and the trap is prevented by the air seal produced by the inflowing air. Tests made on this trap under actual working conditions show that the dust concentration at the worker's breathing zone may be kept down to less than 10 million particles per cubic foot with a 60 cubic foot per minute rate of air flow through the hood. This trap is a step forward in the program of dust removal; however, in underground work, such as in mines and subways, there is still the need to solve the problem of compact dust disposal equipment.

In certain cases, such as in the sandblasting of large castings in sandblast rooms, the practical safeguard to the worker is to provide him with a mask or helmet of the positive air pressure type. In the sandblast investigation previously mentioned, it was found that when from 5 to 6 cubic feet of practically dust-free air per minute are supplied to the helmet, the worker receives ideal protection. However, one must always bear in mind that the ultimate criterion of protection should be the dust determination of the air within the helmet during blasting and not the quantity of the air supply itself.

In most dusty processes, however, the most effective means of dust elimination are by the use of properly designed exhaust ventilation systems. Since in many instances it is difficult, costly, and at times an unnecessary procedure to remove all the dust in the vicinity of a worker, we need first to determine the minimum amount of a certain dust which the worker can apparently tolerate with impunity. Such information can be made available by the type of studies carried out by the Public Health Service. For example, in the granite study already referred to, it dust at *the breathing level of about 10 million particles per cubic foot (35 per cent* free silica).

Studies of dust removal devices used in granite cutting plants at the time this work was conducted showed that a linear velocity of 1,500 feet per minute as measured by an anemometer at the face of the dust-removal hood, would keep the dust at the breathing level to an amount less than 10 million particles per cubic foot.

A word should be said concerning personal respiratory protection against dusts. It has already been shown that in the use of positive pressure respiratory devices in sandblasting, it is important to have a well-designed device supplied with about 6 cubic feet of dust-free air per minute to give full protection to the worker. With reference to respirators of the filter type, there is still much to be accomplished in the design of an efficient and comfortable mask for continuous use. Of great value are standard methods for the testing of the efficiency of respiratory protection devices. Drinker advocates testing a device against the particular dust which the respirator is to encounter, these tests to be made both in the laboratory and under actual industrial conditions. He further suggested that some impartial agency should conduct such tests and certify the devices for industrial use, the work being done on a cost basis. The U. S. Bureau of Mines has prepared such a schedule for testing and approving respirators.

I wish to stress the importance of good housekeeping in the effort to combat the dust hazard. Good housekeeping should not only imply the removal of accumulated dust about a workroom but should also embrace efficient maintenance of dust removal devices and respiratory protective equipment. Systematic inspection of all dust suppression equipment should be an axiomatic principle in every dusty industry rather than the casual attention which it now receives in many instances.

Report of the Nominating Committee

The chairman called for the report of the Nominating Committee at this point, and new officers for the section to serve during the ensuing year were nominated and elected as follows:

National Safety Council's annual proceedings: "When the sample had been allowed to stand from 24 to 48 hours we had a little reaction. Safex itself was very satisfactory but its compounded condition, with a little age, caused dermatitis." Members of this Committee personally saw Dr. Shirley with a sample of Safex on his arm under a piece of adhesive. It had been there for 4 days. He showed the naked arm and it had only a little rash, as stated by him. The test (as made by Dr. Shirley) of fastening samples of Safex and Safex compounds to the flesh for days at a time would not be a parallel condition to employees working with any such compounds.

Reference is made in Mr. Nolan's brief on page 19, to the hazard of x-rays. This hazard might take place in any industry and is not peculiar to the Rubber Industry. In fact there are very few rubber industries equipped with an x-ray machine. The Committee knows of no rubber company where x-rays are used other than in the Medical Department and under the operation of skilled technicians only. Therefore, this illustration, as mentioned by Mr. Nolan, is far-fetched and should carry no weight in this brief as applying to the rubber industry.

Signed: W. L. Schneider, B. F. Goodrich Co., Akron, Ohio.
J. T. Kinney, Goodyear Tire & Rubber Co., Akron, Ohio.
R. B. Morse, Firestone Tire & Rubber Co., Akron, Ohio.
E. W. Beck, United States Rubber Co., New York, N. Y.
Paul Van Cleef, Van Cleef Bros. Co., Chicago, Ill.

October 1, 1934.

ADJOURNMENT

TWENTY-THIRD ANNUAL SAFETY CONGRESS
NATIONAL SAFETY COUNCIL

Safety Section, A R A – Steam Railroad Section, N S C

Chairman—C. L. LaFountaine, Great Northern Railway Co., St. Paul, Minn.
First Vice-Chairman—H. A. Parish, Chicago & North Western Railway, Chicago.
Second Vice-Chairman—W. H. Failing, Central Railroad of New Jersey.
Secretary—J. C. Caviston, American Railway Association, New York City.

A complete report of these sessions is published by the American Railway Association in a booklet entitled, "Proceedings of the Fourteenth Annual Meeting of the Safety Section, Cleveland, Ohio, October 2-4, 1934." 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 2, 1934

The opening session of the Safety Section, American Railway Association—Steam Railroad Section, National Safety Council was called to order by Chairman C. L. LaFountaine, Great Northern Railway, St. Paul, Minnesota, who presided. The invocation was delivered by L. G. Bentley, Chesapeake and Ohio Railway. The report of the Secretary, J. C. Caviston, New York City, in which he outlined briefly the activities of officers and standing committees during the last year, was read and approved. The Chairman then presented his annual report.

Annual Report of the Chairman

By C. L. LA FOUNTAINE

Great Northern Railway, St. Paul, Minn.

The speaker said in part: Let us go back for a moment to the resolution adopted at our annual meeting in 1924, which set a goal calling for reduction, based on the 1923 record, of 35 per cent in casualties to employees on duty, Class I railroads, by

the end of 1930. Many thought at that time that such an achievement would be difficult. What occurred has long been history. The railroads actually brought about a reduction in the casualty ratio of almost double that asked for. Consequently, those who had to do with the making of the goal set in 1931, calling for 33 per cent reduction in employees injured by the end of 1933, felt it highly desirable that they set the goal high enough to tax the maximum efforts of all railroads. Approximately forty railroads accomplished this goal, but the Class 1 railroads as a whole made a reduction of 26 per cent in their casualty ratio. While the safety officers may have a feeling of disappointment at this result, we should be encouraged by the fact that the railroads were able to bring about a reduction in the casualty ratio to employees on duty per million man-hours worked of 26 per cent in a three-year period, which followed a reduction of 7 per cent in the casualty ratio during the previous seven years.

The Committee of Direction now gives you a new mark at which to aim. It is a new goal, calling for a 5 per cent reduction per year in railway employees' injuries during the next six years, 1934 to 1939, inclusive. We feel that this goal will be far exceeded by the railroads now having the higher accident ratios, that it is possible of attainment and will be accomplished by the railroads having lower accident ratios.

The statement furnished by the Bureau of Statistics of the Interstate Commerce Commission, covering accidents reported by steam railways for the first five months of 1934, shows an upward trend in casualties to employees on duty. While I do not deem this increase as particularly alarming under the circumstances, it has provided a warning as to what may be expected with any material additional increase in business, unless effective preventive measures can be adopted by the respective railroads.

The injuries which have brought about this upward trend in our casualty ratio are principally non-train accidents. This is due, in my opinion, to the unusually large increase in the man-hours worked in this branch of the service during the first half of this year, rather than to any inactivity on the part of the railroads in accident prevention work. The railroads were asked to carry on an extensive program of track and equipment maintenance, to purchase rails, cars and engines, or rebuild if the circumstances require. This made necessary a sudden and large increase in the forces, resulting in either the employment of new men or the return to service of men who had been inactive in railroad service for some time. The work that was required of these men in most cases was of a more hazardous nature. For example, in the maintenance of way department the increased man-hours were consumed largely in construction work, relaying of rails, bank-widening and ballasting tracks—heavier work and more dangerous than that of ordinary track maintenance, which has been carried on more generally for the last two or three years. This is also true in the maintenance of equipment department, stripping and rebuilding and steel-underframing cars and heavy locomotive repair work, with large gangs of men, newly organized.

I think we had a right to look forward to a momentary increase in the casualty ratio, but I believe this condition has since adjusted itself and we will be able to bring back our accident ratio to a lower level than it was for the year 1933.

The responsibility for the promotion of safety is essentially a function and problem of management. The success with which it is promoted on any railroad seems likely to be pretty closely in proportion to the attention given to it by executive and operating officials of all ranks, and the enthusiasm for safety they are able to arouse among employees. Never before in the history of railroads have railroad executives and officers given so much thought, time and effort to accident prevention as at the present time. Safety officers should feel greatly encouraged by this fact. Another source of encouragement for safety officers is the pronounced trend toward greater recognition, particularly by persons and agencies which take the lead in moulding public sentiment, of the accident problem. It is probably still true that the gravity of this problem has not been brought home to the average citizen with sufficient emphasis so that he makes it a matter of personal concern, but there are clear indications that the efforts of the National Safety Council and other agencies dedicated to accident prevention will carry forward our fight against accidents in marked strides.

Report of the Committee on Education

By L. G. BENTLEY

General Safety Agent, The Chesapeake and Ohio Railway, Richmond, Va.

The speaker said in part: The Committee on Education was organized *soon* after the setting of the 33 per cent goal, and the purposes of the committee have been three-fold, all educational. In the first place, it was the intent of the committee to educate officers and employees as to correct methods of work and as to unsafe methods of work, undertaking never to set out an unsafe method of work without showing in comparison the safe way of doing that job.

There is another purpose of the committee, and that is to inform railroad men and others throughout the country, and even throughout the world, of the progress of safety work on American railroads.

Then there is the inspirational poster that always commands a better sale than any other class of poster because it appeals to the hearts of men. Every man really down in the bottom of his heart wants to do what is right, and if the mind runs along with the heart, the hand will soon begin to form the habit of traveling in the same company.

I have chosen for discussion from this year's posters a few of the most important, illustrating hazards which have caused more deaths and *more injuries* and more suffering than the other classes of railway employee injuries. (Mr. Bentley then described at considerable length the following posters:)

"Safety Demands a Firm Grip and a Safe Foot-hold."

In 1932 there were 220 train service employees killed in all classes of train service accidents, and of that number 105, or 48 per cent, were killed in falling from engines or cars or while getting on or off engines or cars.

We sold 6,600 copies of this poster to about half the railroads of the United States. That was the equivalent of furnishing one poster for each 30 railroad employees in train service throughout the country. We also sold 34,000 copies of the circular dealing with the same subject, and that was a number equal to one for each six train service employees in the United States. However, they were most all sold to a few of the railroads.

But what has been the result of our campaign for the last ten years during which we have been driving on this particular kind of accident?

The number of train service employees exposed to this particular hazard decreased 37 per cent. The number of employees killed in this class of accident decreased 47 per cent, and the number of employees injured decreased 74 per cent.

"Mishandled Material Means Many Maimed Men."

We distributed this poster in the hope that it would reach the supervisors and foremen and that it *would* make them *more* careful and more diligent in supervising the handling of material. We felt, too, that by getting it to the attention of the men, they themselves would get the idea that for the last ten years on an average fifteen thousand of their number had been injured on American railroads while handling material. That is more than were injured last year in all classes of railroad accidents. 5,000 copies of this poster were distributed.

In 1932 there were seven employees killed and 3,787 injured while handling material. That constitutes 5 per cent of the deaths and 38 per cent of the injuries in all non-train accidents on American railroads.

"Please Sir, Look Both Ways."

There are one *million* railroad employees in the United States subject to the dangers that this poster is trying to cure. In 1932, 128 out of a total of 367 train service accidents, or 35 per cent of all the deaths in train service accidents, were the result of being struck or run over by engines or cars.

I consider this the most difficult problem in connection with railroad men. Not only train service employees, but shopmen and trackmen, station employees, officers from headquarters, every man who works for the railroad is subject to the danger of being struck or run over by engines or cars. It is for this reason that the Committee on Education has produced more posters and more illustrated matter

on this problem than on any other class of accidents. Because every time you have two train service employees injured by being struck or run over, one of them is killed.

A later poster on the same subject was entitled "What a Whale of a Difference a Few Feet Make!" It illustrated the vast difference from a safety point of view that a few feet can make when a man chooses to cross a track quite close to the end of a standing box car, behind which an engine may be approaching, and the same man doing the same thing at such a distance from the box car that he can readily see down the other track whether or not an engine is approaching.

Address

By WILLIAM BUSHNELL STOUT

Member of the Society of Automotive Engineers, and of the *Detroit Aviation Society*

The speaker said in part: When we start any new engineering development we get great punishment for our ignorance. In fact, I sometimes think there is only one sin in the world and that is ignorance, because we do get punished for it, and very quickly. And when we start a new industry of which we know nothing, when we are trying to find out what it is we are trying to do, we are in a very dangerous period of development. Then as we begin to realize and recognize those dangers, and use our intelligence to get around them, we get to a point or development where it is not dangerous any more, only hazardous. Then as we study further and acquire experience we come to a point where that industry by the application of intelligence and study becomes a safe and practical thing.

When we started in on aviation it was dangerous. There is no question about that. As we look back now we know just how dangerous it was. We knew nothing about what we were trying to do. We knew nothing of the stresses in the air. We had an idea that flying wouldn't require any particular strength; if you would just make something that was light enough it would go up in the air. So the first airplanes were made of very flimsy materials, put together with stove bolts, and with under-powered engines. They would just barely get off the ground and we knew nothing about flying. When a man got up and happened to pull the stick back and climbed too steeply so that he lost his speed and by losing his speed lost his lift and fell down, we called that a "nose dive" which was a very fatal thing.

Then we came to the idea—and it was forced on us very emphatically—that airplanes had to be strong. Our airplanes today are built to stand tremendous velocities. I was up in a ship yesterday that *cruises* at two *hundred miles an hour*, which is four times the stress that was felt in the Miami cyclone, and yet this ship sails along without any trouble or interference and is a thousand times safer than the first airplanes that would only go forty miles an hour.

This development was brought about by means of a whole lot of structural analysis. It required a good deal of experimental work to take the guess-work out of the building of the structural part of the airplane.

In the past, while we were learning what was going on, many wings came off. We started in with structures that were designed for flying loads and with a factor of safety of three or four times the flying load. At slow speeds, we got away with it. Then we began to step up the speeds. We got up to around 150 miles an hour and then, without any warning, and with no apparent reason, all of a sudden a wing would stay behind in the air and the airplane would dive ahead.

When one particular accident occurred that was given a great deal of prominence at the time, a very thorough investigation showed the trouble to be compression cracks in spruce spars. In other words, we had been making airplanes of wood and they were perfectly satisfactory at slow speeds because the stresses on the wood weren't sufficient to bother us, but when we got to high speeds the compression cracks began to develop, and after awhile the spar would fracture just like a fatigue crack. Immediately wooden airplanes were dropped from all air lines.

All of these developments have a very direct connection with safety. The newer things bring higher speeds, and on account of the higher speeds they must bring

new methods of stopping, new methods of grade crossing control, new methods of control of the automobile driver, who isn't always as smart as he might be, and a whole lot of other things.

On the air lines we find that the greatest handicap is the human element and undoubtedly we have the same difficulty as is indicated by these posters. In the early days when we first started flying on our lines in Detroit, we had about four instruments on the dash. We had pilots with pretty good training—probably a couple of hundred hours in the air, the best available in that day.

Those pilots would take those planes and fly them. If there was a fog, they would land. They *didn't* know anything about flying *blind*. If they got *into* a fog they didn't know whether they were upside down or rightside up, and no man in the world could tell.

Today, however, things are different. Yesterday in Detroit I rode in a ship at a speed of 200 miles an hour which had about $6,000 worth of instruments on the dash. The dash is a small area and it is just full of instruments of every kind. The pilot who has flown for many, many years can fly blind even better than he can fly when he *looks* out of the cabin. He has a radio beam on which he flies accurately as on a string from one town to another. When he wants to land, he can pull down his flaps and land in a space the length of a good sized room.

As part of his training, every six months the pilot goes out with a Department of Commerce man. He is put in the cabin and everything is shut up so he can't see a thing. They take him out for an hour and lose him. He doesn't know what direction he is going. The instruments are covered. At the end of an hour's time they pull the covers off the instruments and tell him to find out where he is. He has to go through a number of maneuvers first, right and left turns, etc. Then he has to find a certain city and tell the instructor, or the man who is examining him, when he is over the airport.

Suppose they leave from Pittsburgh and fly in the direction of Detroit. They fly for an hour. Well, this other chap doesn't know but what they are down in Washington, because he can go a long distance in an hour, at 200 miles an hour.

At the end of that time, he is turned loose and told to take the Department of Commerce examiner to the airport at Cleveland. He feels around, until he picks up a beacon. He listens to the beacon until he locates it and finds out what beacon it is—between which two cities it is. That gives him his clue as to where he is. Then he takes a compass course until the picks up the beacon running into Cleveland, follows the beacon into Cleveland, and when he gets over the airport, by the landing signal on the beacon, he signals his examiner. If he does that successfully he can fly for another six months or until his next examination.

You will see that we go to the greatest extremes on everything connected with the air lines to insure the safety of passengers because undoubtedly air transportation, to the man in the plane, and everyone else, is the *most hazardous* type of transportation we have developed as yet. For that very reason, it can be made the safest, because we have to take these safety precautions, whether we want to or not.

Progress and Possibilities in the Prevention of Injuries to Railroad Employees

By T. H. CARROW

Superintendent of Safety, Pennsylvania Railroad, Philadelphia

The speaker said in part: In the year 1924, the Committee on Statistics concluded that the bulk of all injuries to employees were chargeable to the human element and that "by improved training, supervision and discipline," which implied the formulation and enforcement of safety rules, a 5 per cent reduction in the casualty rate could be effected each year, which, by the end of 1930, would be equivalent to 35 per cent, which figure was established as the safety goal. It is important to bear in mind that up to 1924, discipline, which was mentioned in the committee's report as a primary means of improving the employee injury record, had not been invoked to any appreciable extent by very many roads.

The concerted effort on the part of all railroads to reach the safety goal gave a tremendous impetus to safety activities. Then began the publication of great quantities of statistical information showing graphically the standing of the respective roads and many railroad executives, seeing their properties lagging on safety, revamped their safety organizations. Those that were already well organized intensified their activities. During the years following the setting of the safety goal, something happened that was unprecedented, and that was a continuous downward trend in the employee casualty rate for ten consecutive years. I do not know of a single railroad that did not make substantial gains for safety during that period.

You will remember that the rate dropped from the peak of 31.15 in 1917 to a low of 24.84 in 1921; that the rate then rose to 30.89 in 1923, and from that date on showed a continuous drop each year down to and including 1931; in which year the rate was 7.52 or 76 per cent under 1923. Nothing like this was ever accomplished for safety before.

Fatal injuries to employees of Class I roads actually dropped from 1,866 in the year 1923 to 488 in 1933. Non-fatal injuries dropped from 148,146 to 14,126. On a man-hour basis, that is, making due allowances for fluctuations in the number of employees in the service, the reduction in employees on duty killed in 1933 under 1923 was 42 per cent and the reduction in injured was 78 per cent.

We have for some time been in a period of marking time in safety, so to speak, preparing for what I believe will be a more intensive and effective campaign during the coming years. In this respect the history of the accident situation is analogous to the history of many other aspects of railroad operation. All through the years in which the railroads were so wonderfully developed there were periods when improvements in locomotives, cars, rolling stock, signalling systems, shop machinery, and methods of operation, respectively, were at a temporary standstill, but in due course and in every direction we find a revival of activity and subsequent improvement.

We therefore come to the question as to the extent of improvement in the accident record of the American railroads it is reasonable to expect. That it is possible to further improve the record is obvious. On this head, the president of the American Railway Association recently stated:

"The employee casualty rate has been reduced 77 per cent during the last ten years. A large reduction in casualties to passengers has also taken place. Notwithstanding this reduction in employee casualties, there is still quite a spread between the high and the low rates among railroads of the same class, indicating that further improvement is possible in the accident record. For example, among the larger carriers (reporting 100 million or more man-hours), the lowest rate in 1933 was 1.68 employee casualties per million man-hours, while the highest was 10.02. Among the smaller carriers (reporting less than two million man-hours), the spread is between 1.01 employee casualties per million man-hours, and 43.97."

One prominent railroad executive believes that accidents can be prevented "to the point of almost total elimination." Safety men probably have different opinions about the matter. It is a fact, however, that can be readily proved by the causes of accidents, that the bulk of all injuries being sustained by railroad employees today, as in former times, result from causes over which the officers, supervisory forces and employees, individually or collectively, do have control; that is, from man failure.

What are the general preventives of man failure? The first preventive is to select the right men for the job. In times past, this was not always possible because the supply of applicants was frequently inadequate. This, however, is not likely to be the case in the near future, so our troubles in this direction should be at an end for a long time at least.

The second preventive is right thinking and right acting. A man must first think how he should act to be safe and then he must act as he thinks. The difficulty comes in getting people to think and act as they should. Now, the way to get people to think and act as they should is as old as civilization: it is by training, a thought we have come to express in the phrase, "training, supervision and discipline," although supervision and discipline are merely two of many phrases of training.

Now, what is the first requisite to training? Knowledge of the subject on

which one is to train another. In safety, it is knowledge of safe practices. These are shown by the causes of accidents and by job analysis. When safe practices are reduced to writing they are usually called rules, or at least they are equivalent to rules. Therefore, if all safe practices in any occupation were reduced to rules and if complete obedience to such rules were secured, it would insure complete immunity from accidents from man failure. This means that the first step in safety is to provide adequate rules; the second step is for local officers and supervisors (the teachers) to know and understand the rules; and the third step is to see that the employees know, understand and obey the rules. In consonance with these observations, the following items are presented for the consideration of the Safety Section as some of the essential elements in an effective safety program:

1. A comprehensive set of safety rules outlining the safe ways of working.
2. A practical, working understanding of the rules or safe practices by all local officers, supervisors and employees, to be assured by suitable examinations.
3. Invariable obedience to all rules, violations not resulting in accidents representing the same degree of culpability as when accidents do result from such violations.
4. Definite and not perfunctory observations by local officers and supervisors to detect violations of safety rules and formal report of violations detected as a requirement of management.
5. Formal disciplinary action on proven violations, with entry on discipline record covering every case.
6. A monthly and cumulative record of the violations of rules or unsafe practices detected by each local officer and supervisor, and a monthly summary by departments for divisions and system.
7. All accidents, regardless of how trivial, shall be reported and investigated promptly to determine cause, responsibility and disciplinary action to be taken where responsibility is shown.
8. Investigation should invariably develop an answer to these two questions: (a) Was accident due to the violations of a rule? (b) If not, should a rule be provided?

TUESDAY AFTERNOON SESSION

October 2, 1934

The "Green Book"

By LEW R. PALMER

Secretary, Committee of Award, Railroad Employees' National Safety Contest and Conservation Engineer, Equitable Life Assurance Society, New York City

The speaker said in part: The year 1933 ended the ten year period of the Railroad Employees' National Safety Contest as set up by the National Safety Council and recorded in the respective issues of the "Green Book."

A constant study of railroad safety contest records during a period of ten years has established what I believe to be a fundamental fact: that it is necessary to break down our entire Class I railroad exposure into a sufficient number of competing groups so that there will not be too wide a variation between the man-hour exposure of the largest group contender as compared with the man-hours of the smaller contenders in the same group; otherwise, the larger unit, with its more uniform casualty rate, will be handicapped by the more widely fluctuating rates of the smaller contenders; for it is generally recognized that under normal conditions the greater the man-hour exposure the more uniform the casualty rates are year by year.

For that reason, the revised plan suggested for the 1934 Railroad Employees' National Safety Contest includes six groups for standard Class I railroads and two groups for switching and terminal roads, it being a matter of record in connection with switching and terminal roads that a great deal more interest has been developed in our annual contest since these roads were given what was considered a fighting chance for competitive honors.

There is one change that has been under consideration on several occasions; that is, the weighting of employee fatalities in our Railroad Employees' National Safety Contest; and it is a subject that I believe should be given serious consideration. Possibly others have noted that in one or two cases small Class I railroads have reported a single employee casualty for the year and—as recorded—that one casualty happened to be a fatality. Other small roads with two or three injuries and no fatality naturally felt that their somewhat larger total casualty rate represented, in reality, a better safety record. On the other hand, we are confronted with a situation which has been recognized by many; that the longer we can keep the respective contenders working hard for first honors, the more accidents will be prevented, and when a fatality occurs on the small road and is weighted by five or ten that road's chances of winning an award have been eliminated. Furthermore, if fatalities were to be penalized through weighting we would find instances where it would be necessary to charge heavily for an accident carrying no violation of rules as against an unweighted injury due to flagrant violation of safe practice. It must be remembered that a fatality, in many cases, is such by virtue of a fraction of an inch or a fraction of a second, or by a number of other uncontrollable variables.

After serious consideration of these phases of the situation it was deemed inadvisable to weight employee fatalities in our Railroad Employees' National Safety Contest, for it was generally conceded that the way to prevent fatalities is to eliminate accident causes, and that too much emphasis on fatal cases might tend to discount the real importance of reportable injuries and the need for investigating the causes of minor injuries and even the near accident that might reveal a serious hazard.

This leads up to another important principle. Years ago it was discovered that the one-day lost-time case was the "lowest denomination" that could, with ultimate safety, be utilized in an employee safety contest.

Report of Committee on Train Accidents

By G. H. WARFEL

Chairman of Committee, and Assistant to Executive Vice President, Union Pacific System, Omaha, Nebraska

The speaker said in part: A train accident is one with or without casualties, arising in connection with the operation or movement of a train, locomotive or car, which results in damage to equipment or other railway property in excess of $150 (including cost of clearing wreck and local expense of transferring lading, but not damage to the lading).

The outstanding features revealed by the 1933 statistics on train accidents are:

1. A slight increase in frequency of occurrence, particularly derailments.

2. Several accidents with an unusually large number of persons hurt, notably rear end collisions.

3. A greater number of casualties than in any year since 1930, resulting in a casualty rate per million train miles 5 per cent above 1930, instead of the 33 per cent reduction hoped for.

5. Train accidents accounted for 22 of the 48 passengers and travelers killed and 65 of the 468 employees killed (on duty) in accidents on Class I railroads.

The year's total of 5,623 train accidents of all kinds occurring on the road and in the switching yards is the smallest number ever recorded in any year. It includes 1,219 collisions, 3,291 derailments, 478 locomotive breakdowns and 635 miscellaneous accidents. There were 153 persons killed and 1,252 injured, exclusive of trespassers, both figures being higher than in the preceding year.

When these accidents are classified by causes, we find: 1,713 due to negligence of employees; 2,324 due to defects in or failures of equipment; 656 due to defects in or improper maintenance of way and structures; 930 due to miscellaneous causes.

The forms of negligence most disastrous from the standpoint of human casualties in 1933 were: first, disregard of fixed signals; second, excessive speed in violation of restrictions; third, failure to properly protect by flagmen; fourth, overrunning meeting points with other trains; fifth, switches set in wrong position.

While the frequency rate of train accidents showed a small increase in 1933 as compared with the remarkably low figure of the preceding year, the rate of 7.22 accidents per million train miles run remains much lower than for any year prior to 1932, and represents a reduction of 63 per cent under the base year of 1922. The frequency rates of collisions and derailments are slightly higher in 1932, while locomotive and miscellaneous accidents attained a new low frequency of 1.43 per million train miles.

However, when we look at the figures for human casualties in train accidents, we find there has been a disturbing increase in both fatal and non-fatal injuries, the total casualty rate for 1933 being higher than for any year since 1929. This increase in casualties was due almost entirely to the unusual number of persons killed and injured in four or five accidents occurring on different roads. There were 83 persons legitimately riding on trains killed in train accidents in 1933, including trainmen, persons carried under contract and passengers, as compared with 61 the preceding year. Moreover there were 1,099 trainmen, persons carried under contract and passengers, injured in train accidents in 1933, as compared with 779 in 1932.

The 1,219 collisions, which involved 42 passenger trains, resulted in 32 fatalities and 630 injuries exclusive of trespassers. Certainly, the imperative necessity for taking all possible practical measures for the prevention of collisions must be obvious to every officer, supervisor and employee on American railroads, when it is realized that more than 200 casualties resulted from a single accident of this character last year. The conclusions of the I. C. C. Bureau of Safety investigators in each of the major rear-end collision cases reads almost the same: "Failure of an engineman properly to obey signal indications and stop at signals of a flagman."

In many other reports of similar accidents with a smaller toll of casualties, the conclusions reveal violations of rules by various employees as well as enginemen, and in several cases referred specifically to failure of operating officers to properly enforce observance of rules.

The press and public usually ascribe such occurrences to "human fallibility," and place the onus of responsibility almost entirely on the shoulders and conscience of the erring employee. Without any desire to minimize the employee responsibility, candor compels us to point out that there are occasional cases in which the greater degree of responsibility properly rests upon the management and operating officers of the railroad involved, for their failure to utilize methods which have been found highly effective for prevention of such accidents. We refer to the inauguration of continual bona fide surprise tests, carefully arranged to assure the surprise feature, made by men who truthfully report every detail of the actual performance of all members of the crew, and followed by severe and unremitting discipline for failure or negligence in any detail of performance. These vigorous measures must, of course, be preceded by a thorough campaign of education and examinations to assure that the operating rules are fully understood, not only by the rank and file of employees, but by dispatchers, trainmasters, road foremen of engines, superintendents and supervisors in mechanical and maintenance of way departments.

Preventing Collisions and Derailments Due to Negligence of Employees

By C. H. LONGMAN

Assistant to General Manager, Chicago and North Western Railway Company, Chicago

The speaker said in part: An analysis of the collisions and derailments on my own road shows that 88 per cent of the collisions and 25 per cent of the derailments can be traced to the failure of employees to observe the rules or special instructions.

One of the most serious derailments which we have had was due to the failure of the engineman to properly control the speed of his train on a four degree curve.

which resulted in the death of an engineer and a fireman and injury to other members of the crew. He endeavored to negotiate that curve at 55 miles an hour, while the maximum speed permissible for passenger trains was 25 miles.

In order that we might prevent accidents due to excessive speed the Division Officers as well as the Safety Officers are required to make checks to see that the speed restrictions are complied with and a report of these checks is made to the General Superintendent each month. The train sheets in the dispatchers' office are checked to see that the speed restrictions are not exceeded, and this also serves as a check on the train dispatchers to determine whether or not they are permitting excessive speed in speed-restricted districts. The division engineer from time to time also checks the elevation of the curves to see that the proper super-elevation is maintained.

The only method that we know of preventing accidents due to the disregard of fixed signals by enginemen and trainmen is to make periodical checks each month. This is done by the division and Safety Department officers to see that the men observe the indication of signals.

Failure to provide proper flag protection is covered in Rule 99. On our road we require the general officers as well as the division officers and Safety Department officers, when riding trains, whether freight or passenger, to make it a point to check and see that Rule 99 is complied with in every respect. This is in addition to the assigned number of checks which are made each month by the division officers and reported to the general superintendent.

Failure of engineers on second and third class trains to properly control the speed of their trains within yard limits is covered by Rule 93 of our operating book of rules. The only way that this can be controlled is for the division officers and local officers in the yards to observe the speed at which the second and third class trains move at all times. Violations are promptly investigated and disciplinary action taken.

Collisions and derailments due to switches being set wrong occur mostly in yard limits, so far as our own road is concerned, and the only way in which this can be rectified is for the general yardmasters and yardmasters to see that the switches are properly lined up. Failures on the part of employees to properly line switches back are investigated and disciplinary action taken. Another thing is to check your engineer and fireman and switchman to see that they are looking in the direction they are going so that they will observe a switch that is set in the wrong position.

It has been many years since we have had an accident due to the improper handling of a train order, and this can be credited to the fact that our management has instituted and maintained a systematic check of train orders and train dispatchers.

In my estimation failure to keep proper lookout has been the cause of more accidents than any other one thing. This is particularly true of yard collisions. It was not so long ago when the first thing that a locomotive fireman on a switch engine, working nights, would do would be to look for the "hay board." If the engineer was the sleepy one he would take the fireman's place on the "hay board," and the fireman would run the engine. Today our division officers, including yardmasters, make checks in yards to see that the enginemen comply with the rule which requires them to keep a proper lookout at all times.

Preventing Failures of Car Journals, Wheels, Trucks and Couplers

By W. B. MOIR

Chief Car Inspector, Central Region, Pennsylvania Railroad

The speaker said in part: How can we best prevent failures of car journals?

First, by careful machining and inspection at our wheel shops where the axle is prepared for mounting. A magnifying glass may be used to advantage. Numerous journals have been found with hair-line detail fractures which could not have been discovered with the naked eye, and which if permitted to be returned to service under a car are nothing more or less than potential accidents.

Second, the care and attention given to car journals in the transportation yard in the way of proper lubrication. Many failures of car journals are caused by lack of proper lubrication. Another potential failure of car journals is the sudden cooling of a red hot journal with water. Train crews should not throw water directly on a red hot journal, as the sudden cooling of the outside surface sets up internal stresses which in many cases cause a seam to develop on the surface of the journal, with the result that after the journal is trued and replaced under the car, this seam will develop into a progressive fracture.

The failure of wheels is an intensely interesting problem. Prevention of wheel failures can best be accomplished by careful workmanship at the wheel shops where the wheels are bored and mounted. It is important that the bore be true and the mounting pressure correct.

In the transportation yards, I have found that the average car inspector, through long experience, is highly qualified to pass on wheel defects. There are two general classes of defects. First, those which are liable to cause accidents such as cracked plates, seams and loose wheels; the other defects are in extreme cases liable to cause trouble but not as serious as those listed above, and are chipped rim, worn through chill, shell outs, slid flats, etc.

Train crews should also be on the alert for defects in the case of brakes sticking, and should by all means refrain from throwing water on a hot wheel, as such treatment will result in thermal cracks on tread and flange, as well as cracked plates. Defective brakes on equipment are in many cases the cause of wheel failures, and it is very important that the air brake equipment be kept in good working condition. A careful check should be made of wheels when cars are on the shop tracks to detect defects which are liable to result in an accident.

In the case of multiple wear wheels under passenger cars, we have found that by white-washing the back of the wheel plate and rim, cracks in plate and under side of rim were discovered which could not be detected with the naked eye.

When a car is cut out of service for periodical air-brake attention and after being placed on shop track, a very careful check is made of the trucks, and in the case of arch bar trucks the arch bars are inspected at all bends, front and back, to detect any cracks that may have developed. A mirror is used to examine the back side of the arch bar. Incidentally, this mirror inspection is made on all cars equipped with arch bar trucks, irrespective of whether they are shopped for periodical air brake attention or not. All brake beams are dropped and examination made of the hangers; limits of wear have been established and gauges provided for checking the wear. The same procedure is followed with respect to brake hanger pins and key bolts, all cotter keys and split keys which show evidence of excessive corrosion are renewed.

The same procedure is followed with respect to couplers and draft attachments, the couplers are dropped; yoke and couple examined for cracks at vital points; loose rivets in coupler yokes renewed; couple cross keys checked for wear; all cross keys, if not equipped with A. R. A. cross key retainer, are removed and a modified cross key applied; the distance between stops is checked and corrected, if necessary; loose rivets in coupler steps renewed.

Preventing Derailments Due to Defects In Track, Bridges and Roadway

By A. H. PETERSON

Chicago, Milwaukee, St. Paul & Pacific Railroad, Chicago

The speaker said in part: Among the forces of nature which it is necessary for us to combat are those of temperature, precipitation, wind, and fire. The sudden changes of temperature common to many parts of our country render it extremely hazardous to surface track out of face. Raising should, whenever possible, be done during the cooler parts of the day, and all raised track should be tamped and backfilled as quickly as possible. Rails should be securely anchored, ordinarily in the direction of traffic, but sometimes in both directions.

During the summer months open joints may be unloosened, bars tapped lightly with a maul, and again retightened. Similarly, in cold weather, tight joints may be opened up. Special care should be taken with joints where steel has been laid adjoining rail of lighter section, as there is a constant threat that the light rail may suddenly give way against the thrust of the heavier, more rugged track structure.

Heaving track is a familiar phenomenon to most trackmen in the colder climates. Drainage will go a long way toward eliminating this possibility. There is scarcely a man in track work who does not know that the various soil components, some of which are more retentive of moisture than others, cause track to heave both laterally and vertically. Such joints must be watched carefully, especially when the frost is going out, as the track does not always settle back into position uniformly.

Under the head of precipitation comes snow and rain. Both are a bane to the trackman and supervisor. Heavy and unexpected rain has been responsible for many a derailment. Only last year, on one of our middle western railroads, there occurred a cloudburst, during which five and a half inches of rain fell in a period of three hours. A bridge under which there had not been more than three feet of water for twenty years was forced to withstand the outrush of a fifteen-foot flood.

Heavy rainfall is no respecter of railroad property and adequate flow-ways must be provided. Narrow track shoulders should not be neglected. Wooden bridge ends subject to wash should be riprapped.

A careful system of bank widening should be carried forward yearly. Refuse at the end of cuts should be eliminated and the eroded material dug away. Adequate drainage in all cases by means of proper sewers or ditches must be provided. Ditches in all cases must be deep enough and with sufficient gradient not only to carry away the surface water rapidly but to drain as much as possible of the subsoil as well.

Water-pockets in fills constructed of clay materials offer another danger, due to slides. Usually, due to a strata of porous material surrounded by denser, more impervious soil, the water is held from escaping properly. The supporting top ballast is thereby weakened and many derailments have occurred because of the track structure at such points suddenly giving way under the wheels of a train. The bottom of these water-pockets must be tapped by the proper method of drains. Slopes may be sodded to prevent sliding. Various types of vines—alfalfa or Bermuda grass—not only serve to prevent sliding, but also arrest considerable drifting snow.

Windstorms have caused many train derailments, due to blowing cars off sidings onto main lines of other tracks, or blowing trees, telegraph poles, or other obstacles across the rails. Derails must be provided for at all dangerous points, especially on descending grades. Trees should be cut back to a safe distance from the track wherever possible. In some sections of the southwest, winds are an especial hazard due to the light, sandy top soil drifting. The placing of sand fences, oiling of sandy soil adjacent to railroad tracks, and the planting of resistant vegetation are some of the more common preventives of such accidents.

Wooden trestles on our important lines are rapidly giving way to steel but on our less important lines they will probably be with us for a long time to come. In some cases the tops of wooden trestles have been covered with sheet metal to prevent their ignition from engine coals. Vegetation should be carefully cut away from wooden abutments and inspections carried on systematically to see that this item is not neglected. Weed burners should be carefully followed and all fire in ties carefully put out. If this is not done, all or a portion of the ties in a single panel of track may be consumed, permitting the rail to gush out of gauge or to depress under traffic, and thus lead to a costly train accident.

Nor is the highway crossing free from its hazards. Planks should be taken up before freezing weather begins and all dirt on top of the ties and underneath planks cleaned out.

Flange-ways should receive especial consideration and all ice, snow, or other material cleaned out carefully. Too many derailments have occurred due to snow and ice in flange-ways.

On gravel or dirt ballasted highways there is an added danger due to vehicles dragging stones or dirt upon the crossing and into the flange-way. Here it compacts under traffic, as more and more is deposited, until eventually the wheels of a passing train are lifted up and over the rail. Highway repairmen operating road-scrapers are sometimes careless or ignorant of these dangers. Track foremen should make it their duty to advise all such persons of the possible consequences of this dangerous practice.

So far very little has been said about inspections. It is, however, by regular and careful track inspections that incipient dangers may best be found and corrected. The trackmen, the foremen and the supervisors should train most carefully the men upon whom they are to rely. With sections rapidly becoming longer and longer, it is not always possible for the foreman to supervise his gang and also patrol his track. The track inspector therefore becomes the first line of defense. He must be able to think clearly and rapidly in whatever emergency may arise, always remembering that the safety of the train service rests in his hands.

Moreover, the foreman himself must be ready at all times of high wind, heavy rain, or any unusual weather conditions to patrol his track, and to him is given the power to preserve the lives of passengers and trainmen, and to him is given the privilege of speeding up the wings of transportation.

WEDNESDAY MORNING SESSION

October 3, 1934

Report of Committee on Prevention of Highway Crossing Accidents

By H. A. ROWE

Manager, Claims Department, Delaware, Lackawanna and Western Railroad, New York City

The speaker said in part: The report of this committee for the year 1933 again shows a slight reduction in the number of accidents and fatalities at railroad highway crossings and a substantial reduction in the number of injuries for the fifth consecutive year since the year 1928. The record is as follows:

Year	Accidents	Fatalities	Injuries
1928	5,800	2,568	6,667
1933	3,235	1,511	3,697
Reduction	2,565 (44%)	1,057 (41%)	2,970 (44%)

Casualties during the four months of June, July, August and September in the Careful Crossing Campaign, compared with the same period, 1928 to 1933, inclusive, were as follows:

Year	Accidents	Fatalities	Injuries
1928	1,799	858	2,092
1929	1,827	749	2,140
1930	1,371	640	1,505
1931	1,103	496	1,196
1932	899	432	1,022
1933	990	491	1,124

It will be noted that automobile registration in 1933 was 23,827,290, and represents an increase of 1.4 per cent over the preceding year; this is quite comparable with the number of automobiles registered in the peak year of crossing accident casualties.

Gasoline consumption, which is a fair barometer of automobile use, was 16,025,562,000 gallons during the year 1933; which is an increase of a trifle less than 2 per cent over the preceding year. The increasing use of smaller cars with greater mileage per gallon of gasoline, indicates that the traffic over and across railroad tracks was fully equal to that of 1932.

More than 92 per cent of all railroad-highway crossing casualties involved the operation of automobiles. The remaining 8 per cent included persons in animal-drawn vehicles, bicyclists, pedestrians, etc.

To the credit of the automobile driver, and the activities of the railroads, attention is called to the increasing number of automobiles actually in use, at highway crossing, the figure now being one death to 15,769 automobiles. Crossing accidents, resulting in injuries, are also favorably reflected, as during the past year there was but one crossing injury to each 6,443 automobiles operated.

Illustrative of the thoughtlessness of some motor car drivers, it is interesting to note that in 1933, again, motor vehicles colliding with the sides of trains accounted for a large number of all crossing accidents; namely 28 per cent of all accidents, 17 per cent of the fatalities, and 40 per cent of the injuries.

Your committee earnestly recommends that the individual railroads particularly stress the necessity of their train crews and others giving adequate and timely warnings to the public of the approach of trains to a highway crossing. The committee is also unanimous that warning from engine should be continued until the crossing is definitely reached.

That suitable standardized methods of protection be employed, where necessary, at crossings, to facilitate uniformity and the public understanding of the signals.

That crossings be periodically inspected and maintained in sound travable condition.

Your committee also recommends that greater advantage be taken of the opportunity of presenting the crossing safety subject to school children throughout the nation, in similar fashion to the way this work is being conducted by some roads, particularly the Atlantic Coast Line. It is also recommended that officers or suitable representatives of railroads present the crossing accident situation at luncheon clubs and other places where men gather, this work often reaching those who are employers of drivers of motor car vehicles.

Summary of Conditions and Practices Involved In Certain Accidents

By W. J. PATTERSON

Director, Bureau of Safety, Interstate Commerce Commission

The speaker said in part: It is difficult to discuss the subject of railroad accidents without appearing to take a more or less critical attitude concerning the existing situation. Obviously, there would be no such accidents unless defects existed, rules were violated, or someone failed to think or act in a safe manner.

Last fall the Commission investigated a rear end collision on an eastern railroad in which 14 persons were killed and 32 injured. The accident occurred on a double track line equipped with automatic block signals and an automatic train stop device. The engineman of the following train received a calling-on signal indication at the entrance to the block in which the accident occurred; this signal authorized him to proceed at "restricted speed," which was defined in the book of rules. The engineman operated a forestalling lever of the automatic train-stop device and entered the block at a low rate of speed; at that time he knew the block was occupied by another train, having been following it when it entered the block, but he assumed that it would keep moving and consequently allowed the speed of his own train to increase with the expectation of proceeding as far as the next automatic signal; however, the preceding train, which was out of sight around a curve, stopped short of that automatic signal on account of switching operations ahead. The engineman of the second train was looking across the curve in order to pick up the indication of the automatic signal and failed to see the rear of the standing train or its flagman until too late to avert the accident, although he had a view of the standing train for a distance of about 900 feet. The rule under which his train was proceeding was simple and easily understood. It was evident that the employees did not have a clear and correct understanding of what was meant by the term "restricted speed" and that proper effort was not made either to observe or enforce the requirements of the rule.

Shortly before the accident above referred to, there were two other accidents which were of an unusually serious nature. One occurred in the southwestern section of the country and was caused by a flood resulting from a cloudburst having washed away the fill supporting one of the abutments of a bridge, permitting it to collapse under a train; while the other occurred on an eastern railroad and also involved flood waters, the center pier of a bridge having been undermined. In the first of these two cases not only did it appear that the washing away of the fill could have been guarded against by rip rap or other protective measures, but the need of such protection had existed for two years. In addition, rains earlier in the month had resulted in the bank of the stream and also the toe on the slope of the fill supporting the abutment, being washed sufficiently to direct attention to the need for protection. Local residents using the highway had observed the condition and recognized the possibility of danger to the railroad bridge but no representatives of the railroad had made sufficient inspection to discover the condition. One of the functions which must necessarily accompany the safe operation of a railroad has to do with the taking of protective measures before actual danger develops.

In the second case involving flood waters, the undermining of the center pier of the bridge permitted it to settle under a passenger train, resulting in the derailment of the entire train, the death of two persons and the injury of twenty others. The piers of the bridge had been built on a gravel foundation, no provision being made to guard against scouring, because it was stated that the gravel was too compact to pern it the driving of piles. American Railway Engineering Association rules covering inspection of bridges provide in part that the inspection of foundations should include an examination for indications of scouring or undermining, and that when necessary, soundings should be taken for this purpose. The evidence of this case indicated that the company had made no underwater inspection nor taken any soundings for the purpose of detecting possible scour at any time subsequent to the erection of the bridge 29 years previously.

Speed has been a factor in a number of the accidents which were investigated. One of these involved the derailment of a passenger train due to excessive speed on a sharp curve, the evidence indicating that the engine turned over from centrifugal force, without marking the ties between the rails, while traveling at a speed estimated to have been from 50 to 65 miles per hour, although the speed of passenger trains on the curve where the accident occurred was restricted by slow board to 30 miles per hour. The other accident in which speed was a factor involved failure properly to control speed in an occupied block; this is a frequent cause of accidents. This accident occurred on a single-track line, trains being operated under a manual block-signal system. The first train had 113 cars with a helper behind the caboose, while the second train had 127 cars with two engines on the head end and a helper behind the caboose. After passing the last block office the first train had been stopped and shortly afterward was struck by the following train. More or less fog had prevailed, and it was very foggy in the vicinity of the point of accident. Investigation developed that the second train passed the last block office 41 minutes behind the first train, made no stop en route, and had proceeded at an average speed of about 23 miles per hour, whereas the maximum permissible speed for freight trains with helper engines was only 25 miles per hour and under the rules a following train in an occupied block was required to be operated under such control that it could be stopped short of a train or obstruction.

The brief references I have made to accidents investigated by the Bureau of Safety during the past year do not represent unusual conditions. Accidents of this kind are encountered in our work year after year and are detailed in our accident investigation reports made public from time to time. Many railroads are availing themselves of the information contained in these reports to aid in discovering and correcting dangerous or undesirable conditions and practices on their lines before they result in accidents.

Certain railroad officers devote their entire time to safety work, yet they are seldom found at the scene of a train accident or in the investigation room. A train accident is a serious matter. It may and frequently does result in a considerable number of deaths and injuries, and large property loss. Surely the fundamental idea of safety applies to train operation and the methods and practices followed in

connection therewith, yet the duties and responsibilities of safety officers do not appear to include operating conditions and practices which vitally affect the safe handling of trains and the maintenance of the track and equipment involved. In the case of each of the accidents to which I have referred, there was not a single recognized safety officer present at the investigations.

In connection with the non-observance of rules which was involved in some of the accidents I have mentioned, there is one matter which I desire particularly to call to your attention. Frequently an investigation indicates that employees have been doing or have been failing to do certain things in violation of the rules until it develops into an established practice and this practice finally results in an accident. Under these circumstances the employee usually is held at fault. Rules and instructions governing the operation of trains are based on years of experience and are the result of careful deliberations of the best minds among experienced railroad operating officers; yet there are occasions when these important rules are not enforced, violations being overlooked as a matter of expediency. An operating officer assumes a grave responsibility if in his desire to expedite the movement of traffic he permits violations of the rules to go uncorrected. The rules of various railroads differ, but all of them have the same ultimate object in view, namely to insure that signals are displayed behind a train to provide adequate protection. In many instances however, it is common knowledge that in order to avoid delay the flagman is not expected or required to comply with the rules. On some roads the flagman starts back promptly and continues for a proper distance or until recalled. But on others he loiters around the rear end or is not expected to go back any great distance; when those things are observed frequently the natural inference is that the employees are reflecting the attitude of those charged with enforcement of rules on the particular railroad involved. Another example of rules being frequently overlooked has to do with speed. I venture to say that violations of speed restrictions or rules governing speed are among the most common rule violations on the railroads of this country. Out of 87 accidents investigated by the Bureau during the fiscal year ended June 30, 1934, excessive speed was involved directly or indirectly in at least 17 cases.

To avoid accidents, there are two essential principles to be kept in mind; first, rigid enforcement of and obedience to rules so that as a result of instruction, training and practice the employee will, in case of emergency, instinctively do the right thing; and secondly, thorough investigation of all accidents for the purpose of ascertaining not only the immediate causes but also the underlying factors leading up to the immediate causes, and then applying the proper remedies or preventive measures.

Report of Committee on Train Service Accidents

By D. G. PHILLIPS

Superintendent of Safety, Wabash Railway, St. Louis, Mo.

The speaker said in part: Our record of train service accidents shows that in 1933 a total of 4,598 persons were killed and 15,107 persons injured. Confining the figures to employees on duty, we find that a total of 329 were killed and 6,032 were injured. Of these 209 trainmen were among the killed and 120 were other employee fatalities. And among the injured, 5,468 were trainmen and 564 other employees on duty.

The relative importance of train service accidents as compared with accidents of all classes becomes evident when you note that out of a total of 500 employees killed on duty in 1933, of these 329 were classed as train service accidents, while of the 15,583 employees injured in 1933, 6,032 were injured in train service accidents. When major injuries alone are considered, the proportion of those injured in train service accidents is much higher. Another thing that makes the matter of train service accidents of great importance is that nearly all of these accidents are preventable: in other words, hundreds of employees are killed and thousands injured unnecessarily.

The causes of accidents of this class and the remedies to prevent accidents of this class are just what they were a year ago, and just what they were four years ago. The task before us therefore is not to discover causes of accidents and not to discover what the remedy is, for these have both been made apparent years ago. The important thing before us, then, is what to do, or rather how to get the remedy applied. Let us look, then, at some of the outstanding types of these accidents.

Coupling or uncoupling cars or locomotives. The Interstate Commerce Commission figures show that in 1933, 12 persons were killed and 246 injured; and that of these 9 trainmen were killed and 238 injured, and 3 other employees were killed and 8 other employees injured. This type of accident is the one in which speed seems to be accountable for most of the injuries but in reality they are the result of violation of rules.

Those in supervisory capacity should see to it that men in this class of service, as well as all others, fully understand that a request for work to be done in less time is not in any way to be considered as permission or invitation to violate safety rules to accomplish the task.

Operating hand brakes. Of the 15 persons killed and 514 persons injured in 1933 while operating hand brakes, all were employees on duty. All those killed and 511 of the injured were trainmen. While there was an increase of 25 per cent in fatalities when compared with 1932, the number injured decreased 13 per cent. There has been a steady improvement in the total number of casualties, the figures for 1933 showing a reduction of 55 per cent under 1930.

In studying the causes of these accidents, we find considerable evidence of lack of forethought and care on the part of the men.

It is recommended that a definite educational program be instituted with concentration on the following suggested subjects: the importance of first sizing up the job quickly and thoroughly from all angles; the different types of hand brakes, method of operation; brake clubs, examination for strength and proper use of; position of feet on brake platforms and manipulation of the pawl; importance of secure footing, particularly in winter; importance of having a firm grip; precautions taken with brakes that are set too tightly; precautions to be taken when on a moving car or on a standing car.

Getting on or off cars or locomotives. The total number of persons killed in this manner in 1933 was 516, while the total injured was 3,785. Of these 15 employees were killed while on duty and 1,345 injured; 11 of the killed were trainmen and 1,266 injured, while other employees killed numbered 4 and 79 injured.

This tabulation shows progress. When compared with 1930 the total casualties to employees on duty decreased 52 per cent including a reduction of 67 per cent in fatalities. There was a decrease of 19, or 56 per cent, in the number killed and a decrease of 204, or 13 per cent, in those injured as compared with 1932.

The chief causes of accidents under this classification are falling, either due to slipping or tripping, getting on or off cars or locomotives while in motion, and stepping down on uneven roadbed or on obstructions. Many of these accidents occurred at night or during inclement weather and some were due to defective equipment. Most railroads have safety rules in effect which, if complied with, would have prevented a great many of these accidents. The greatest progress can be made by rigidly enforcing the rules and applying suitable discipline in individual cases of rule violations.

Operating locomotives. In 1933, 5 persons were killed and 834 persons injured while operating locomotives, all of them being employees on duty.

Accidents under this classification are generally due to the failure of enginemen to comply with the operating rules of the railroad, as well as the safety regulations established for their protection. Many improvements can be made in the method of cleaning fires, handling coal, as well as the methods of using fire tools, and it is recommended that safety officers give particular attention to this subject.

One of the outstanding causes of serious and fatal injuries under this classification is the taking of water at water plugs in all kinds of weather, and in a great number of instances the inefficiency of operation is due to the lack of proper maintenance of these water plugs. The unexpected movement of the locomotive plays its part in the serious phase of injuries under this cause, and proper cooperation by the men on the locomotive is essential to eliminate this type of accident.

The operation of stokers and power reverse gears, squirt hose and other me-

chanical equipment call for constant education and training to eliminate them as potential accident hazards.

Operating switches. Although none were killed in this manner in 1933, 176 persons were injured, all of them being employees on duty. Of these 165 were trainmen and 11 other employees. The reduction of casualties due to operation of switches has shown a very marked decrease over *1930, 2 killed in 1930 against none* in 1933, 378 injured in 1930 as against 176 in 1933. This indicates that employees are exercising more care while handling switches.

Of the causes leading to these injuries we would enumerate the following as the most important: insecure footing; haste in attempting to throw the switch; improper position of man throwing the switch; switch hard to throw; and unsafe conditions around switch. The first three of these causes might all come under the single heading "haste."

Before attempting to throw the switch a man should be sure his footing is secure, that his body is free of the movement of lever, and he should never take it for granted that the switch will be easy to throw; because of variable weather conditions, the switch that is easy to throw today will be hard to throw tomorrow. A man should never undertake to jerk the switch lever over; because if he jerks on the lever with the expectation that it will move easily when for some reason it is hard to move, injury is apt to result. He should always take a firm hold and throw the switch over with a steady uniform movement, being sure that there is no obstruction that will catch his hand in the movement of the switch lever. Those whose duty it is to keep the switch in good working condition, and to keep the vicinity of the switch clear of unnecessary obstructions, should see that this duty is performed. Switches need frequent inspection.

Struck and run over not at public crossings. The total persons killed in 1933 numbered 1,792 and 958 persons injured. Among employees on duty 101 were killed and 146 injured; of these 32 killed were trainmen and 74 injured, and 69 killed were other employees and 72 injured.

The reduction of employees killed on account being struck and run over not at public crossings is very marked, 231 having been killed in 1930 as compared with 101 in 1933. I think this good showing has been largely brought about by the special attention given to the elimination of the causes of such accidents.

An examination of casualties under this heading classifies nearly all of them as due to one of three causes: (1) failure to look both ways before stepping on the railroad track; (2) walking on the railroad track or foul of the track when possible to walk elsewhere, and (3) walking too close to the end of a car in a live yard.

Practically all of these injuries are easily capable of being eliminated. The remedy is apparent and may be briefly stated as follows: (1) always look both ways before stepping on the railroad track; (2) never walk on the railroad track or foul of the track when possible to walk elsewhere, and (3) never go within ten feet of the end of a car in a live yard.

Getting On or Off Cars and Engines and Operating Hand Brakes

By E. A. MEYER

Manager, Safety and Fuel Departments, Chicago, Milwaukee, St. Paul and Pacific Railroad, Chicago

The speaker said in part: Accidents resulting from the operation of hand brakes show an increase of 3, or 25 per cent, in fatalities during the past year. In all there were 15 killed and 514 injured. You can plainly see that here is a field for some intensive work to cut down these injuries that are so unnecessary. Very few of these accidents were caused from faulty equipment and a great many were due to falls, losing hold, slipping or losing balance. I believe that we could cut down these accidents to a minimum if an educational program were carried on among employees.

I am happy to call your attention to the fact that accidents due to getting on or off cars or locomotives show a decrease, only 15 employees being killed instead of 34, a decrease of 56 per cent. Instead of 1,949 being injured, there were 1,345 injured or a decrease of 13 per cent.

All of these accidents due to getting on or off cars or locomotives were due to the following unsafe habits: uncertain hand or footholds, attempting to get on or off when not competent to do so, inability to see where they were alighting, and alighting on rough, uneven or slippery surfaces or on frogs or switches, or carelessness.

Before we had safety rules, men were getting out of gangways of locomotives facing outward and performing other hazardous stunts, trusting to luck that they would alight like a cat, on their feet standing up. These were unsafe habits and it has been hard for some of the older men to break themselves of such habits.

One of our master mechanics had a habit of getting down out of the gangway of an engine when facing outward. He realized it was a dangerous practice and that he was setting a bad example for his men. One day he did this as I happened along and he remarked to me: "I am going to break myself of that habit." So he deliberately got on and off the engine several times in the proper manner until he felt sure of himself; and then he remarked to me: "That is the last time I am going to bungle the job of getting off an engine." Moreover, he stuck to the good habit. In other words—he crowded out a bad habit with a good one.

Coupling and Uncoupling Cars and Engines and Air and Steam Hose

By D. A. KLUMPH

Supervisor of Safety, Pere Marquette Railway, Grand Rapids, Mich.

The speaker said in part: In the coupling and uncoupling of cars and locomotives, we were able to show a reduction, comparing 1933 with 1930, especially to trainmen,—and they do most of that work.

A comparison of the injuries to employees from this cause, for the past four years, shows conclusively that it is not rules alone that will stop these injuries because if there is any one thing that is adequately covered by the rules it is this kind of work. To quite an extent, it is the older employee who is injured in performing this work, and it seems to be due to his opinion that because of his experience in the old link-and-pin days he can still go between moving cars without injury. But in most cases he will not allow a member of his crew to do it because of the danger involved.

Because all injuries of this type are caused by violation of rules, it is within the power of the operating officials to stop these accidents through rigid enforcement of rules.

Coupling and uncoupling air or steam hose: we find that comparing 1933 with 1930, we have had more fatalities and fewer injuries in 1933.

The principal cause of these injuries seems to be failure to reduce the air brake pressure before endeavoring to uncouple the hose, and perhaps a more rigid rule in regard to this might be introduced with good results.

Another cause for many of the serious accidents is failure to protect the workman with blue signals or otherwise in compliance with the blue flag rule. These violations in many cases are too often caused by the desire on the part of someone to gain time at the expense of safety.

As to the rule situation, which is my pet hobby, because I have been pretty closely connected with it for a number of years, I feel that we can have too many rules. It seems to me that the more rules we have, the greater number of violations to rules occur. It is a good deal the same with rules as with our laws. We have so many that the average man doesn't know he is violating the law in what he is doing.

Struck or Run Over—Not At Public Crossings

By D. G. PHILLIPS

Superintendent of Safety, Wabash Railway, St. Louis, Mo.

The speaker said in part: Last year, out of 500 employees killed on the railroads of the United States, 101 were killed because of being struck and run over, not at public crossing—almost one-fifth of the total number.

Nearly all fatalities and injuries due to being struck and run over can be classified under three heads: first, stepped on the railroad track without first looking in both directions; second, stood or walked on the railroad track when he could have walked some place else; third, walked too close to the end of a car in a live yard.

All railroad employees and other persons know, without anybody telling them, that those three things are dangerous and unsafe. They know they shouldn't do them and they don't want to get hurt or killed. Then why is it, when all of them agree on those things, that 101 railroad employees were killed in that way last year? That is the answer that you and I must find out. The answer is, in an offhand way, supervision. But you have said nothing, you have solved no problem when you say, "supervision." When you say "supervision" you must include that course of conduct on the part of supervisors that secures the cooperation of the men.

There are a good many things that are done in the exercise of supervision. In one of our shops not long ago, the shop superintendent found a man without goggles doing what is known as "goggle work." He promptly suspended him for five days and sent him home. That is supervision—one kind of supervision, or, rather, a part of supervision. It had a wonderful effect, especially on the other fellows.

A few days later, this shop superintendent heard that the man's family was in very destitute circumstances. We were only working about 6 days a month at that time, and he lost five days of the six on account of not wearing his goggles. The shop superintendent went out to that man's house. He had five little children, two of them under five years of age, and the only food of any kind in that house was one-half loaf of bread. This was in the winter time and all they had was one stove, a cook stove.

The superintendent was so moved that he came back to the shop and took up a collection of about $20 and presented it to this man's wife.

A short time afterward, when the man came back to work, he thanked me with tears in his eyes for the money we had given him. I told him that we had not given the money to him, but that we had given it to his wife.

"Well," he said, "I will tell you one thing, Phillips; you will never find me guilty again of doing that kind of work without my goggles on."

And the question with me, gentlemen, is which had the strongest influence on that man's action, the five days' time which he lost, or the help that was given his family in a time of need?

Here is some more supervision. Mr. Cole told me this story the other day. He went down to his shop round-house, and found a man who was not wearing goggles when he should have been wearing them. He called him down off the engine where he was at work. He knew the man's circumstances, that he was just about ready to get his home paid for. I don't remember what the fellow's name is, but Cole said, "George, you have violated the goggle rule."

George knew it. He said "George, you have a little girl in your home, eleven years old, who has never, because of infantile paralysis, been able to put her feet to the floor. You have a wife who is already worn out with the care of that invalid child. George, if someone would go to your home and tell your wife that you have been blinded in both eyes, how would you feel, knowing that you were no longer able to help care for that little invalid and to help her mother in the struggle to keep things going?"

George had stood with his head down while Mr. Cole was talking to him. He looked up with tears in his eyes. He said, "Mr. Cole, I have never been talked to about safety in that way before. I have always thought there was a lot of hooey in this safety movement. But I now realize what it means to me, and you can rest assured that never again will I do that kind of work without my goggles on."

That is some more supervision. Notice the results. Don't think for a moment that I am deprecating punishment for non-enforcement of rules. Safety rules should be adopted and they should be rigidly enforced by whatever methods are necessary to cause the employee to comply with them. But enforcement is only a part of supervision.

Here is some more supervision that brought good results. On the Wabash Railway this year we laid 60 miles of new 110-pound steel. We had a gang of 115 or 120 section men engaged in that work. About the time they started this work we happened to have a division safety meeting within four or five miles of where this camp was. The supervisor, a Mr. Watkins by name, loaded his fellows up and brought them in to the safety meeting.

I was there and I told them just how to do their job without anybody getting hurt. About three months later, they completed that job, and not a single man had been injured.

WEDNESDAY AFTERNOON SESSION

October 3, 1934

Interesting Employees in Looking After Their Own Safety

By J. CLYDE MIXON

Chief Clerk to General Superintendent, Northern Division, Atlantic Coast Line Railroad Company, Savannah, Ga.

The speaker said in part: One of our South Carolina philosophers, Bob Quillan, once said: "If we would pray more often for common sense, we would not have to pray for rain." Expand that thought for yourselves. Safety is common sense in action.

"Interesting employees in looking after their own safety" is but another way of saying, "Sell the idea of safety to your men." Before one can sell anything to someone else one must sell oneself. You may be sure that in a section where there is a poor safety record it is primarily the result of the indifference of a supervisory officer, or the result of his inability to sell the idea to his men and keep them sold on it.

We must keep everlastingly at this proposition of safety. A wise man who lived in the Orient once said: "Nothing is ever definitely finished among men, for each thing stops only to begin again." We can put that down as a law of nature. It has been said that "eternal vigilance is the price of safety", and that is quite true. We must constantly drive home the doctrine of safety mindedness.

If the supervisor is indifferent, there isn't anything to do about it but "decapitate" him, and the sooner the better, because it is an indication not only of narrowness but of his unworthiness to be a leader of men and a representative of enlightened management.

It should not be difficult to get men interested in looking after their own safety. The first law of nature, the law of the jungle, the law of self-preservation, is or should be invoked by every worker. It requires some time, however, for men to be sold on this idea—that they must look after themselves. There is also, of course, the appeal to a man's higher nature, the duty he owes to his family, then to his fellow workers and the public whom he serves.

But I want to approach this subject largely from the angle of responsibility and the opportunity of the supervising officer. It thrills me sometimes when I think of the opportunities the supervising officers—the foreman, the master mechanic, the trainmaster, the superintendent—have if they exert themselves as the leaders of the men working under their supervision. What an opportunity this man has to accom-

plish something worth while in this brief span of life, where we are all put here for a purpose, and where true happiness is derived from doing something to help our fellow man.

Men can be led. We see evidence of this every day. We see men being led by unscrupulous leaders and demagogues into destructive paths. Unfortunately the vast majority of men, it seems, like to have someone else to do their thinking for them. This trait of human nature should be capitalized by the supervisory officer not only in his efforts for better safety but in aiding him to carry on all the activities for which he is responsible. After all, safety is really a synonym for efficiency. Where there is a poor safety record there will also be found a state of inefficiency.

The supervisory officer must, therefore, so sell himself to his men as to become their leader, their authority, their guide, their teacher. It has been done, it can be done, and it must be done if the supervisor is to live up to his responsibility in this age of ever advancing progress and complexity, and if he is to maintain his right to hold a supervisory position. This angle—the opportunity of the supervisor—has been neglected in the past. The supervisor can and should be made a development agent for loyalty. Someone has wisely said that "an ounce of loyalty is worth a pound of cleverness."

Our discussion naturally leads us into the question of discipline, highly necessary in any organization where large numbers are employed. However, the chief meaning of this word discipline is not "correction" or "chastisement" or "punishment"; but the foremost definition is this: "the treatment suited to a disciple or learner; education; development of the faculties by instruction and exercise; training, physical, mental or moral."

Education is a potent factor in this business of safety, just as it is in any worthwhile undertaking. We have our established channels of education and instruction in this safety movement. We have our committees. We have our organizations. However, these orthodox methods are not always sufficient. Interest sometimes lags. It is your job and my job to see that interest is sustained.

Education of the right kind must come largely from personal tutorship. Here again, the responsibility and the opportunity of the supervisor must be stressed. An employee does not reach perfection when he has passed an examination, or when he has been promoted from one rank to another. It is a constant, unending process of evolution and development. Our scheme must be fitted to meet the needs of the hundreds of ever-changing personalities with which we have to deal.

Someone has said that the standard rule book is the railroad man's Bible. This leads me to mention a practice on our road that may not prevail everywhere. Attendance at our safety committee meetings is not compulsory, though they are usually well attended. We find, however, some disinterested, unloyal (perhaps rather than disloyal), workers who do not receive the benefit of what transpires at the safety meetings. Attendance at our rule meetings, a series of which is usually held semi-annually, is compulsory. Our trainmasters, who usually conduct these rule meetings or schools, invariably devote a period of time to a lecture on the first rule in the book: "Safety is of the first importance in the discharge of duty." Moreover, in discussing all the rules, the safety aspect is not forgotten and is stressed.

This question resolves itself to a great extent into a study of the science of personnel management. It is a big subject. Some railroads and many other industries have personnel departments, but those in charge of such departments act only in a general way. The immediate supervising officer is the keynote of the success of healthy personnel relations in any establishment, and great indeed is his responsibility as well as his opportunities.

I would like to close my talk to you with these words from that great soul, Elbert Hubbard, whom I am fond of quoting: "The man who is worthy of being a leader of men will never complain of the stupidity of his helpers, of the ingratitude of mankind, nor of the inappreciation of the public. These things are all a part of the great game of life, and to meet them and not go down before them in discouragement and defeat is the final proof of power."

Report of Committee on Non-Train Accidents

By C. F. LARSON

Superintendent of Safety, Missouri-Pacific Lines, St. Louis, Mo.

The speaker said in part: The report of our committee (which has been distributed to all delegates) shows that there are greater numbers of injuries occurring in non-train accidents than in train and train service accidents combined. You might get an erroneous impression from this, that there is a higher casualty rate in that type of occupation than in train and train service occupations. That is not true. It is because there are more men working in those two occupations—maintenance of way and maintenance of equipment—than in the others. Therefore, there is more exposure to injury and more accidents occur.

I have taken some figures from the I. C. C. reports with respect to the casualty rate among non-train employees and I find that under the head of maintenance of way and structures in 1933, in Group A, the larger railroads, the average was 6.03 as against 12.04 in transportation; in Group B it was 5.68 in maintenance of way as against 13.03 in transportation. The ratios in Group A were from 1.48 to 13.99 in maintenance of way.

To give you many of these classifications would take too much time. However, in Group D we find a peculiar situation. These ratios per million man-hours under the head of maintenance of way start with none (not a single reportable casualty on one road) and run up to 34.26. Under maintenance of equipment for your mechanical men, in Group A, the average was 5.88 as against 12.04 in transportation. In Group B, the next largest railroads, the average was 6.03 as against 13.03 in transportation.

So it would appear that while we have been worrying about the greater number of accidents prevailing under the head of non-train occupations, we are making a better record than they are in the transportation department.

Falls of Persons and Handling Materials and Tools

By ALBERT A. MILLER

Engineer, Maintenance of Equipment and Structures, Missouri Pacific Railroad, St. Louis, Mo.

The speaker said in part: In the maintenance of way departments of our railroads, between 90 and 95 per cent of the men engaged are handling materials or tools when they work. They are ordinarily doing things under the direction of someone who has been delegated to accomplish certain definite results with men, materials and tools. These men are subject to orders and will do that which is a reasonable demand upon their efforts. Where direction is proper and the results to be obtained are discussed and made plain, men ordinarily perform in an orderly and harmonious way.

Where men, materials and tools together are involved, only one of the three has intelligence. The other two—materials and tools—have no intelligence, no thought and no ideas. They move or are moved entirely without any power within themselves. Men are not at the mercy of matter; material and tools are not masters but servants; they can be controlled and made to answer thought whenever and wherever man wills it so.

But men do have weaknesses that should be adequately covered by a factor of safety. Some of the weaknesses of men are fear, timidity, lack of capacity to concentrate, lapses in clear thinking brought about by the jarring testimony of the senses, thinking beyond the act instead of synchronizing a clear thought with the act.

These weaknesses are the unseen fractures in thought. Why is it not just as logical and just as reasonable to overcome these weaknesses of thought by adding more thought as it is to overcome the weaknesses in matter by adding more matter? Should we not expect almost like results?

Based upon experience and the best thought that could be brought to bear upon

the matters involved, we have provided rules which, we say, if thoughtfully and conscientiously followed should prevent accidents,—not only those of a kind involving men falling on account of the handling of materials and tools—but most accidents of all kinds.

When accidents do happen, we investigate to determine, if possible, the underlying causes. Information brought together following such investigations is broadcast in order to give others the benefit of the conclusions.

There is, I believe, a very much stronger tendency and a more lively disposition to dig down and uproot underlying causes now than obtained a few years back. Just to superficially examine into an accident is dangerous, if it is expected to use information so collected for giving out to others; if the examination into the underlying causes is exact and complete, then information from such analysis sent out to others will surely bring some worth while results.

Assume that all men read the rules which should govern them and that they understand them: assume that they hear and comprehend the proper words of advice and direction as they come from sources of dependability and seasoned thought; assume that the thought of self preservation is generally as strong in one man as in another; and further assume that clear thinking during the processes of ordinary functioning is as available to one man as to another—would there then be as many falls of persons due to handling materials and tools as now obtain?

Then why do we continue to have such accidents, and why don't we do those things which will prevent them?

The real reason why we continue to have such accidents is that we are persistent law breakers: our weaknesses manifest themselves: clear thinking is then submerged in a sea of confusion with the result that some law, rule or regulation is violated and the result is usually disastrous.

The reason that we don't do those things which will prevent these accidents is that supervision has not yet made up its mind. When supervision definitely and courageously sets itself to the task of finding and providing an adequate factor of safety for men, then the weaknesses of men will be as impotent to do harm as the weaknesses of material—shackled as they are by a factor of safety.

Falls of Objects; Motor Cars—Care and Operation

By G. B. FARLOW

Division Engineer, Baltimore & Ohio Railroad, Pittsburgh, Pa.

The speaker said in part: The usual accident from falling objects consists of track employees being struck by falling stone in cuts, or from coal or other lading falling from passing cars, and such accidents in the bridge and building department as dropping of tools from overhead, dropping of blocking or other materials from bridges, buildings and structures on employees working underneath.

The majority of these accidents are preventable—those involving trackmen by the observance of the general rule of properly clearing all running tracks at the approach of trains; and in the other crafts, largely a matter of discipline in the gang. Well organized gangs, properly supervised, can so regulate their tasks that it will not be necessary for men to work directly above one another, where they might be struck by objects falling.

The cure is obvious: give the employee the proper training, insist on the proper discipline, and this class of accidents, in a large measure, can be overcome.

The subject of "Motor Car Care and Operation" is one that is of major importance in the maintenance of way department. The care of the motor car is primarily the responsibility of the employee in charge. It is his duty before placing the motor car on the track for movement to determine by careful inspection, that it is in safe operating condition. It is important that supervisory officers frequently check condition of cars assigned to foremen, signal maintainers or other employees authorized to use them. It is the supervisor's duty to so impress his subordinates that they will take no chances by operating a car with defective brakes, operating equipment, running gear, safety railing or deck.

It is, however, the railroad's responsibility to furnish cars of safe construction. There is still in operation on a number of railroads the type of car which is not safe to run. My opinion is based on a number of personal encounters, as well as the sad history of unfortunate accidents to others. This type of car is known as the "side load car." It consists of a frame, the engine and seating arrangement being placed directly over one rail and equipped with one or two wheels on opposite rail of lighter construction in the form of an outrigger. The design of this type of car is fundamentally a hazard due to the fact that the center of gravity is not over the center of wheel bearing but carried over one rail.

There are many improvements that can still be made to lighten the weight of rail motor cars used for inspection service and those for medium and heavy duty. There is a crying need for improvement in the manner in which tools are carried on such cars—a source of potential accidents. I can think of no more severe casualty than that which would result from tools falling off a motor car while traveling at maximum speed permitted by the rules. Tools falling from the car might easily cause a disastrous derailment, and men on the car in such a catastrophe would have no opportunity of avoiding injury.

Safety rules have, therefore, been designed to overcome such a hazard. They consist usually of a cautionary admonition to place the tools and material carried on such cars in a secure position and remind the foreman or other employee in charge that he is responsible to see that tools are in a secure position; but I ask you, in all fairness to these men, whether the provisions made for carrying necessary tools by track gang or bridge gang on a motor car are such that they can be placed in a secure position?

I believe that the method of carrying tools on a motor car could be improved upon; the motor car can be so designed that a suitable receptacle under the seating arrangement of the car can be provided and designed to fit tools normally required, and when such tools are placed within this receptacle entirely encased on both sides, ends, bottom and top, that such class of accidents can be prevented. Until such improvement is made in the design of motor cars, it is important that supervisors frequently check their gangs to determine if the necessary tools are placed as securely as possible and the responsibility of watching them definitely assigned to individuals in the gang.

Eye Protection and Safe Clothing

By J. C. MILLER

Shop Superintendent, New York, Chicago & St. Louis Railroad, Conneaut, O.

The speaker said in part: Eye injuries happen so suddenly and without warning that even the safest worker cannot avoid them without the mechanical protection of goggles. How far this protection should be carried, I have not personally decided. There are few places where it would be unsafe to wear goggles constantly, and yet sometimes they should not be worn, that is where the head room is not sufficient and the vision is obstructed by the goggle.

We have had some bad head cuts from wearing goggles in such locations. However, on the whole, to prevent eye injuries every employee should be provided with proper fitting goggles, and compelled to wear them when doing any work that may result in injury to the eye, or when in close proximity to work that might result in flying particles.

In considering safe clothing, it is an established fact that any loose sleeves, neckties or other apparel should not be worn around moving machinery. Safety shoes, leggings, etc., are very helpful. In a large organization, where stock can be carried subject to purchase by the employees, such protection readily available can reduce the number of accidents by their use.

In allowing gloves around drill presses, boring mills and lathes to place and remove material, employees should be educated that these gloves must not be worn during the actual time any of the machines are in motion. Any infringement of this requirement should remove the privilege of wearing gloves to handle the material at all, even at the expense of a few scratches and cuts. There is not a more dangerous job than wearing gloves around moving or rotating machinery.

In the repair yards we have augmented our blue flag protection with lock switches and flags equipped with a derailing device in many instances. Too much stress cannot be placed upon carefulness at all repair yards. The car repair tracks should be locked and the blue flags placed by a man or men carefully selected for this job. When the time for removing the locks and flags to allow the tracks to be switched or other work to be placed arrives, the greatest possible care should be taken to warn everybody along the repair tracks of the move contemplated, and equal care must be given to the relocking and placing of flags when switching is done.

On our road, we do this by whistling and by personal warning to each employee before the engine is allowed to come onto the track. Any violation of the blue flag rule is severely dealt with, and yet with all our precautions, we have had one fatal injury in the car repair yards during the present year.

It has been my experience that men are very seldom injured on any job where the danger is apparent, that is on work that is inherently dangerous. Injuries and hurts generally occur on jobs where one would think, at first glance, no danger was present. It stands to reason that if every employee had someone standing over him to warn him of the hidden dangers in the work he was doing, no injury would occur. But this method of preventing accidents is of course impossible.

Substitution for such a procedure was built up to a certain extent in the mind of one employee by the association of ideas. For instance, if a man would associate safety with his hands, and every time he noticed his hands, think of safety, or every time he thinks of safety, look at his hands, in a short time such a workman whose work is done by his hands, would so establish this thought in his mind that as soon as he started to work and his hands came into view he would naturally look around to see what hidden dangers there may be in the vicinity of the job he is starting, and in a very short time this process of thought would become mechanical, the same as driving an automobile or any other physical effort in which we engage that is somewhat complicated, and in which the movements are done subconsciously when perfected.

Falls of Persons and Objects

By L. M. GRANGER

Tool Room Foreman, Erie Railroad, Hornell, N. Y.

The speaker said in part: Of the thousands of men injured on American Railroads, every third man has received his injuries in connection with a fall or falling object. Some of the conditions which lead to injuries from falls and falling objects are as follows:

Poor condition of floors, platforms and walks; aisles not kept open; material carelessly piled; poor ladders and scaffolds; poor lighting; material falling from cranes, cars, engines, trucks, skids, etc.; window glass becoming loosened by vibration of cranes, steam hammers, etc.; poorly maintained counter shafts, line shafts, pulleys and belts; poor tires on trucks; oil and grease on floor, platforms, cranes, etc.; failure of cables or brakes on traveling cranes; material leaning against walls; flying rivet heads and chips; coal falling from tanks; insecure footing and hand holds; stepping over loose material; slipping on rails; ladders slipping; getting on and off moving locomotives; cars, trucks, turn tables, etc.; throwing material from cars, engines; loose clothing, greasy gloves.

A modern railroad shop is a busy place. Exposure to possible injury menaces the workman from all sides and from above and below. The traffic density through the main aisles of the shop often equal that of the main streets of our towns. We do not have the service of traffic lights or officers to direct it.

In our shops we mark the aisles with white lines and strive to keep them open at all times, the power trucks move in prescribed directions and as far as possible follow regular routes. All material is moved on skids or tote boxes to eliminate excess handling. Skids are carefully loaded under the supervision of foremen to minimize the danger of parts falling or jarring off.

Each department has available a hand lift truck with which to move the skids in

or out of the department without waiting for a power truck, which leaves no alibi for having the department cluttered up with material on which no work is being done. Each power truck driver tries out his brakes and horn at the beginning of the day's work. Trucks are inspected, greased and oiled at regular intervals and all necessary repairs promptly made. Where the load overhangs the body of the truck a workman precedes the truck to clear the way.

Electric traveling cranes are carefully inspected and repaired each thirty days by a competent machinist and electrician who give special attention to brakes, cables, limit switches, hand rails, etc. A record is kept of these inspections to fix responsibility for any oversight. Each crane operator tries his brakes, horn and limit switch at the beginning of his trick.

Crane operator will not move crane or hoist load except by signal from the floor nor will he move any load if the hitch does not appear safe to him. Endless rope slings are used for moving light material with smooth surfaces to prevent slipping; endless steel cables and load chains are used for handling heavy material. Special slings are provided for handling bundles of flues or units, which wrap entirely around the bundle to prevent dropping any part of the load. All chains used for lifting are annealed each month; the length of chains adjusted and hooks reshaped if necessary. A record is kept of this inspection. The floor space under cranes is illuminated by flood lights, high overhead. Each crane has a spot light for use of the operator.

Line shafts, countershafts and overhead belts are rapidly being eliminated by installation of individual motor-driven machines. That portion which remains in shop is inspected daily. All ladders are equipped with safety spikes. All hose and handle tools are repaired under supervision of the tool room and are inspected when issued.

To assist in checking on all these conditions and the enforcement of safety rules, we have a group of our Safe Practice Committee make a weekly inspection of the entire property and render a written report of all physical defects and all violations of rules. This committee has authority to remove from service at once any defective equipment found, also to stop any unsafe practices they observe. They dismiss from their minds everything except safety and concentrating on the one object, they accomplish much that might otherwise be overlooked. We also have a committee of supervisors who make a weekly inspection of all departments, whose duty it is to observe and report on housekeeping conditions and place two prominent signs, one reading "Dirtiest Department in the Shop" and one "Cleanest Department in the Shop." The unwelcome sign never remains in the same department a second week.

With all our precautions, we still have injuries due to falls and falling objects. I have yet to investigate a case that was not primarily due to carelessness or thoughtlessness, not always carelessness on the part of the victim but carelessness on somebody else's part. In my opinion three things are essential to safety:

1. A safe place in which to work.
2. Safe tools and equipment.
3. Intelligent and alert workmen.

There is no place in industry for the careless workman. He is and should be eliminated. The employee who is injured through carelessness is a marked man and had better watch his step. We do not however believe in discipline as punishment for violation of safety rules. Discipline as education is a valuable weapon. Most men will react favorably to a frank discussion of their faults.

We of the Safe Practice Committee try to study each man who is injured or who violates the safety rules through carelessness to determine why he failed to think, what occupied his mind to the exclusion of his own welfare, how to wake him up, and consider all methods fair that attain results. If the offender is an old man, we remind him that an accident might end his career of usefulness to his employer, that his advanced age would automatically keep him out of further employment elsewhere. The fear of a dependent old age haunts every working man beyond fifty years. The middle aged offender is reminded that his carelessness might seriously interfere with his ambitious plans for the education of his children.

A different appeal is needed for young men and boys. Old age and its attendant problems are a dim and distant picture to them. If they have given any thought at all to marriage and family life, it appeals to them only as a glorious adventure, but they do think of sports. When we remind them that an accident might slow them up on the baseball diamond or the football field or might cramp their style on the dance floor, we talk their language and get their attention. We draw upon all our store of patience, all accumulated knowledge of human nature gained through years of experience, to get our safety message across.

Station and Warehouse Accidents and Their Causes

By J. ROMANOFF

Supervisor of Freight Operation, Erie Railroad, Cleveland, O.

The speaker said in part: A freight station, freight house, or transfer is only as safe as the agent wants it to be.

Investigation of accidents generally reveals that the real causes are carelessness, thoughtlessness, failure to comply with safety rules, lack of experience, and indifference to unsafe practices on the part of supervision.

This latter cause is, as a rule, directly or indirectly responsible for the following unsafe conditions or practices around freight stations: the gang plank that is not secured; the supposedly empty carboy; poor housekeeping; the container or material temporarily placed on platform or aisle; lack of sufficient help on heavy shipments and truckloads; improperly balanced truckloads; improper stowing, piling or loading; the heavy shipment loaded on two-wheel truck when dolly should be used; the slippery platform that has not been salted or sanded; defective equipment; the handling of sheet steel, threaded valves or other freight with sharp corners or edges without gloves; the trucker who is careless in his trucking in and out of cars.

The responsibility for the prevention of accidents rests with the agent, and his attitude is reflected in the actions of his supervision. Accidents cannot be eliminated without intelligent direction and the active cooperation of every employee. Cooperation depends entirely on the attitude assumed by the supervision and their ability to point out to employees in a diplomatic and impressive way what the results from unsafe conditions and practices are.

Here are a few safety suggestions supervision might well follow:

1. Be safety minded, wholeheartedly and enthusiastically.
2. Conduct safety campaigns with the same thought and intelligence that they conduct their station operation.
3. Eliminate all hazardous conditions and practices.
4. Secure the confidence and respect of all employees in order to get the necessary cooperation.
5. Consider the character of the person they are talking to and in selling safety make it personal. Be interested in the employee and his family. Make him realize that safety is of vital importance to him, to his employer, but also to those dependent upon him.
6. A new employee should be properly instructed on how to do his job safely and efficiently, and during the period of his apprenticeship should receive special attention from his immediate supervisor, who should see that he is coupled during his training period with a safety-minded employee.
7. Supervision should prevail upon employees to report any and all unsafe conditions and practices regardless of how minor they think they may be.
8. An injured employee should not be permitted to return to work until authorized to do so by the doctor. The employee returning to work before he is able to perform his duties properly is only a hazard to himself and to his fellow employees.
9. A supervisor should make intelligent use of safety pamphlets, bulletins, circulars, slogans, and rules.
10. Supervision cannot sit back and be satisfied with past activities on safety. The job will not be finished until all accidents are eliminated and all circumstances making accidents possible are wiped out.

Report of Committee on Non-Train Accidents

By C. F. LARSON

Superintendent of Safety, Missouri Pacific Lines, St. Louis, Mo.

The speaker said in part: Your attention is again directed to the fact that non-train accidents exceed both train accidents and train service accidents combined. According to the records of the Interstate Commerce Commission, 118 persons were killed in non-train accidents in 1932, representing 22 per cent of the total killed; and 9,417 were injured in non-train accidents the same year, representing 58 per cent of the total injured.

It would seem that the main effort against non-train accidents should be carried on in the maintenance of way and maintenance of equipment departments, since they produced 77 per cent of all railway employee accidents outside of train and train service classification. This 77 per cent is divided between the two departments as follows: 36 per cent maintenance of way, with 3,436 casualties, a casualty rate therefore of 7.78; 41 per cent in maintenance of equipment and stores, with 3,946 casualties, a casualty rate of 6.94.

In planning a campaign on non-train accidents it is the thought of this committee that particular attention should be directed to the four principal classes of accidents in the departments affected. These classes are as follows:

Falls of persons, 25 killed and 1,654 injured, a casualty rate of 17.6.

Handling tools and materials, 5 killed and 2,949 injured, a casualty rate of 31.0.

Falls of objects, 7 killed and 968 injured, a casualty rate of 10.2.

Hand and Motor Cars (care and operation non-train only), 25 killed and 730 injured, a casualty rate of 7.9.

All other classes of accidents, 56 killed and 3,116 injured, a casualty rate of 33.3.

Your committee again calls attention to the fact that eye injuries are not set out in the Interstate Commerce Commission's statistics, but are undoubtedly included among other causes and should not be under-rated. Injuries to the eyes are among the most serious casualties that industry must grapple with and, therefore, rules governing the use of goggles in all hazardous occupations must be enforced. Frequent check-up with track forces should be made by roadmasters to know that section and extra gangs are supplied with the requisite number of goggles. Mechanical department supervisors should be held to a strict accountability for observance of the goggle rule.

In conclusion, your committee would suggest the following "Ten Point Program for Safety Work," to be a part of the daily thought and activity of every supervisor and safety leader:

1. Set a safe example, and otherwise show by word and deed an interest and belief in accident prevention, and a will to get results in this feature of the work.
2. Act promptly on every correctible and removable unsafe condition observed by or reported to you.
3. Let no unsafe act or practice go unchallenged, but seize the opportunity to prevent the inevitable result.
4. Make it a part of the daily game to find and counsel or correct the uninformed, thoughtless, indifferent, careless or reckless ones—outlining safe methods of work and giving specific warnings of hazards and methods of meeting them to both old and new men.
5. Search out the cause or causes and responsibility for every personal injury, and after finding the defect in man, method, material or condition, use the information towards preventing another similar accident.
6. Plan and oversee every unusual job and the more hazardous kinds of regular work.
7. Foster the widest possible spread of interest in accident prevention.
8. Keep the safety bureau informed of safety ideas and measures adopted by you which might be extended over a larger territory.
9. Raise the standard of physical and mental well being wherever practicable, as one of the greatest factors in safety efficiency.
10. Check up constantly your own safety work and that of your associates.

Report of Resolutions Committee

The report of the Resolutions Committee was then called for and it was presented by Robert Scott, Chairman, Director of Department of Insurance and Safety, Atlantic Coast Line Railroad Company, Wilmington, N. C.

"Be It Resolved by the Safety Section of the American Railway Association in Fourteenth Annual Convention assembled at Cleveland, Ohio, October 2 to 4, 1934, inclusive, that the thanks of the Association be extended to:

"Mr. Lew R. Palmer, Conservation Engineer, The Equitable Life Assurance Society, for valuable work in the preparation of railroad employee casualty statistics, covered by 'The Green Book';

"Mr. William J. Patterson, Director, Bureau of Safety, Interstate Commerce Commission, for his presentation of 'Summary of Conditions and Practices Involved in Certain Accidents Investigated by the Bureau of Safety,' also for his presence and offer of continued association and cooperation of the Bureau of Safety in furthering the work of Accident Prevention on the American Railways;

"The retiring Chairman, Mr. C. L. LaFountaine, General Safety Supervisor, Great Northern Railway, for ably guiding the affairs of the Section during his term of office;

"All other officers of the Section for their faithful and energetic services during the past year;

"Mr. F. M. Metcalfe, Superintendent of Safety, Northern Pacific Railway, for his intelligent and untiring efforts as Chairman of the Program Committee, thereby contributing largely to the success of the Fourteenth Annual Convention;

"All other Committees for their zealous work in such a commendable cause as the conservation of human life and limb;

"The Management of the Hotel Cleveland for their contribution to the well being and comfort of our membership and guests;

"Be It Further Resolved: that these resolutions be spread upon the records of the Section and that the Secretary transmit a copy to all of those recognized herein."

The report of the Resolutions Committee was duly accepted, and passed by the delegates in the usual way.

Report of Election Tellers

The Chairman then called for a report of the tellers on election of officers for the Section during the coming year, and this report was presented by H. S. Corbin, Chairman of Committee, Atlantic Coast Line Railroad, as follows:

Chairman, T. H. Carrow, Superintendent of Safety, Pennsylvania Railroad.

First Vice Chairman, W. H. Failing, Claims Attorney, Central Railroad Company of New Jersey Reading Company.

Second Vice Chairman, C. F. Larson, Superintendent of Safety, Missouri Pacific Lines.

Members of the Committee of Direction:

Eastern Territory: H. R. Cole, Assistant to Vice President, Erie Railroad; and Chas. E. Hill, General Safety Agent, New York Central Lines.

Western Territory: L. F. Shedd, Superintendent of Safety, Chicago, Rock Island and Pacific Railway.

Southern Territory: D. H. Beatty, Superintendent of Safety and Sanitation, Southern Railway.

Committee on Nomination: Isaiah Hale, Safety Superintendent System, Atchison, Topeka & Santa Fe Railway, Chairman; C. H. Blakemore, Superintendent of Safety, Norfolk & Western Railway; D. A. Klumph, Supervisor of Safety and Examiner of Rules, Pere Marquette Railway; H. C. Murphy, Superintendent of Safety, Chicago, Burlington and Quincy Railroad; J. C. Yocum, Manager, Safety Department, Chicago, St. Paul, Minneapolis and Omaha Railway.

ADJOURNMENT

Textile Section

Officers 1933-34

General Chairman—CHARLES H. EAMES, Lowell Textile Institute, Lowell, Mass.
Vice-Chairman in Charge of Program—IGNATIUS MACNULTY, 81 Wallace St., Malden, Mass.
Vice-Chairman—M. W. HEISS, Proximity Manufacturing Co., Greensboro, N. C.
Vice-Chairman—B. R. BROWN, Columbia Mills, Inc., Chicago, Ill.
Secretary and News Letter Editor—E. E. PLACE, American Mutual Liability Insurance Co., Boston, Mass.
Engineering Committee Chairman—PAUL W. VIETS, Plymouth Cordage Co., North Plymouth, Mass.
Membership Committee Chairman—E. G. PAIGETT, North Carolina Industrial Commission, Raleigh, N. C.
Poster Committee Chairman—FRED W. SEHL, Aetna Life Insurance Co., Hartford, Conn.
Statistics Committee Chairman—J. T. TROLINGER, American Bemberg Corp., and American Glanzstoff Corp., Elizabethton, Tenn.
Members at Large—
ARTHUR BARLOW, Armstrong Cork Co., Lancaster, Pa.
RUSSELL T. FISHER, The National Association of Cotton Manufacturers, Boston, Mass.
WALTER HUMPHREYS, National Association of Wool Manufacturers, Boston, Mass.

TUESDAY MORNING SESSION

October 2, 1934

The opening session of the Textile Section was called to order by Acting Chairman E. E. Place, American Mutual Liability Insurance Co., Boston, Mass., who presided. Chairman Place introduced George Richman, Secretary, Richman Brothers Company, Cleveland, Ohio, who made a brief welcoming address to the delegates on behalf of the Convention City.