

**PLAINTIFF'S
EXHIBIT**

tabbles®

NSC-3

1934

TRANSACTIONS

National Safety Council

Incorporated

TWENTY-THIRD ANNUAL
SAFETY CONGRESS



Cleveland, Ohio

October 1 to October 5, 1934

The Cleveland, Carter and Statler Hotels

Copyright, 1935, National Safety Council, Inc.

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

CONTENTS

	PAGE
Council Officers and Directors.....	4
Council Purposes and Policies.....	9
Annual Meeting of Members.....	11
Annual Banquet	21
Subject Sessions—	
Dust in Industry.....	23
Fire Prevention in Industry.....	31
Fusion Welding and Cutting.....	41
Industrial Nursing	45
Industry and Its Motor Vehicle Accident Problem.....	51
Maintaining Interest in Safety.....	59
Mechanical Methods of Handling Materials.....	67
New Workers	73
Poisonous Fumes and Vapors.....	79
Safety Equipment	85
Safety Organization and Program.....	93
Safe Use of Chemicals in Industry.....	99
Safe Use of Electricity in Industry.....	103
The Injured Worker.....	113
Why People Fall.....	121
All Ohio Day.....	127
FERA Safety Conference.....	131
Industrial Safety Lectures—	
Selling the Safety Idea.....	135
The Psychology of the Safety Movement in Changing Times.....	140
Accident Prevention Equipment Manufacturers' Section.....	149
Aeronautical Section	153
A. S. S. E.—Engineering Section.....	159
Automotive and Machine Shop Section.....	163
Cement Section	177
Chemical Section	187
Construction Section	199
Delivery, Taxicab and Bus Section.....	209
Food Section	219
Marine Section	227
Meat Packing, Tanning and Leather Industries Section.....	245
Metals Section	255
Mining Section	269
Paper and Pulp Section.....	289
Petroleum Section	307
Power Press Section.....	325
Public Utilities Section.....	337
Quarry Section	349
Refrigeration Section	357
Rubber Section	365
Safety Section, ARA—Steam Railroad Section, NSC.....	383
Textile Section	413
Transit Section	419
Wood Products Section.....	435
Index	445

National Safety Council

Incorporated

HONORARY MEMBERS

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS

ROBERT W. CAMPBELL

ARTHUR WILLIAMS

OFFICERS (1934-1935)

JOHN E. LONG, President.
ROBERT I. CATLIN, Vice-President for Public Safety.
D. D. FENNELL, Vice-President for Public Relations.
LEW R. PALMER, Vice-President for Safety Councils.
ALBERT S. REGULA, Vice-President for Engineering.
C. W. SMITH, Vice-President for Industrial Safety.
R. T. SOLENSTEN, Vice-President for Membership.
DR. C. H. WATSON, Vice-President for Health.
A. W. WHITNEY, Vice-President for Education.
W. E. WORTH, Vice-President for Finance and Treasurer.
W. H. CAMERON, Managing Director and Secretary.

EXECUTIVE COMMITTEE (1934-1935)

A. L. ARMSTRONG, Eastman Kodak Company.
C. H. AGEL, Past President.
J. I. BANASH, Past President.
C. W. BENQUIST, Past President.
F. W. BRAUN, Wood Products Section.
W. H. CAMERON, National Safety Council.
ROBERT W. CAMPBELL, Past President.
T. H. CARROW, American Railway Association.
ROBERT I. CATLIN, Aetna Casualty & Surety Company.
J. E. CULLINEY, Bethlehem Steel Company.
LEWIS A. DEBLOIS, Past President.
MARCUS A. DOW, Past President.
D. D. FENNELL, Consulting Engineer.
D. L. FENNELL, Kansas City Safety Council.
CAPT. E. W. FISKE, JR., Marine Section.
R. B. FORTUNE, Lehigh Valley Safety Council.
HARRY GERBERT, The Pullman Company.
MORRIS C. HOLT, Automotive & Machine Shop Section.
G. I. HORTSMITH, Chicago, North Shore & Milwaukee Railroad Co.
DR. HENRY G. HORTSMITH, Street & Highway Traffic Section.
THOMAS P. KEARNS, Industrial Commission of Ohio.
WALTER G. KING, Past President.

Officers and Directors

FRANKLIN M. KREHL, Evanston Safety Council.
JOHN E. LONG, The Delaware & Hudson Railroad Corp.
THOS. H. MACDONALD, United States Department of Agriculture.
E. J. MEIBER, Portland Cement Association.
I. W. MILLARD, Accident Prevention Manufacturers' Section.
HAROLD L. MINER, E. I. duPont de Nemours & Co., Inc.
ARTHUR T. MOREY, Past President.
LEW R. PALMER, Past President.
C. E. PETIBONE, Past President.
C. E. RAELSTON, Western Pennsylvania Safety Council.
ALBERT S. REGULA, Industrial Relations Counselors, Inc.
LT. COL. H. A. REKINGER, Past President.
GEORGE W. SEXTON, General Electric Company. —
ROBERT L. SCHMITZ, Louisville Safety Council.
HARRY A. SCHULTZ, United States Steel Corporation.
CHARLES B. SCOTT, Past President.
LESTER D. SEYMOUR, Aeronautical Section.
C. W. SMITH, Standard Oil Company (Indiana). —
WALTER DENT SMITH, Delaware Safety Council.
R. T. SOLENSTEN, Elliott Service Company.
CLARENCE P. TAYLOR, Massachusetts Safety Council.
C. P. TOLMAN, Past President.
J. A. VOSS, Metals Section.
GEORGE H. WAREL, Union Pacific Railroad Company. —
DR. C. H. WATSON, American Telephone & Telegraph Company. —
A. W. WHITNEY, National Bureau of Casualty & Surety Underwriters. —
W. E. WORTH, International Harvester Company. —
ARTHUR H. YOUNG, Past President.

DIRECTORS (1934-1935)

FREDERICK ARCHER, Child Education Section.
WILLIAM F. ANDERSON, Safety Div., Milwaukee Association of Commerce.
A. L. ARMSTRONG, Eastman Kodak Company.
WILLIAM H. BAKER, Quarry Section.
J. I. BANASH, Consulting Engineer.
H. D. BANTA, Paper & Pulp Section.
ERNEST W. BECK, United States Rubber Products, Inc. —
W. A. BENNETT, Worcester Safety Council.
C. W. BENQUIST, Western Electric Company. —
DAVID S. BEYER, Liberty Mutual Insurance Company.
E. F. BLANK, Jones & Laughlin Steel Corp.
C. E. BOKKENHAGEN, Kenosha Safety Council.
F. W. BRAUN, Wood Products Section.
COL. PHIL H. BUCKMAN, St. Louis Safety Council. —
FREDERICK D. CALLEW, Baltimore Safety Council.
W. H. CAMERON, National Safety Council.
T. J. CARNEY, Chicago Safety Council.
T. H. CARROW, American Railway Association.

6 *Twenty-third Annual Safety Congress—National Safety Council*

ROBERT E. CATLIN, Actua Casualty & Surety Co. —
 CARL C. CLEMENTS, Refrigeration Section.
 RUSCOE D. CONLIN, Railway Safety Council.
 H. HERBERT CONSON, Safety Dept., Nashville Chamber of Commerce.
 J. E. CULLINEY, Bethlehem Steel Company.
 EDWARD DANA, Boston Elevated Railway.
 E. A. DAVIDSON, Consulting Engineer.
 RICHARD H. DAVIS, Blackstone Valley Safety Council.
 CHARLES D. DAWSON, Grand Rapids Safety Council.
 LEWIS A. DEBLOIS, Consulting Engineer.
 JAY E. DECKER, Mason City Safety Council.
 JAMES B. DOUGLAS, The Philadelphia Gas Works Company.
 LOUIS I. DUBLEN, Metropolitan Life Insurance Company. —
 CHARLES J. EAMES, Textile Section.
 D. J. FENNELL, Consulting Engineer.
 D. J. FENNELL, Kansas City Safety Council.
 DONALD A. FINKBEINER, Toledo Safety Council.
 CART E. W. FISKE, JR., Marine Section.
 HOWARD R. FONDA, Burroughs Wellcome & Co. (U. S. A.) Inc.
 R. B. FORTUN, Lehigh Valley Safety Council.
 E. N. GORUSTINE, Construction Section.
 OTTO M. GRAVES, The General Crushed Stone Co.
 HARRY GILBERT, The Pullman Company.
 ISAIAH HALE, The Atchison, Topeka & Santa Fe Railway Co.
 MERLE C. HALE, Automotive & Machine Shop Section.
 MAJOR BOLLING H. HANBY, Richmond Safety Council.
 D. T. HARRINGTON, United States Bureau of Mines.
 G. T. HELLMEUTH, Chicago North Shore & Milwaukee R. R. Co.
 CHAS. E. HILL, New York Central Lines.
 HON. HAROLD G. HOFFMAN, Street & Highway Traffic Section.
 CLAUDE J. HOLDING, Albany Safety Council.
 JULIUS W. HORRE, Hudson County Safety Council.
 HARRY D. ISMEL, Pennsylvania Dept. of Labor & Industry.
 IREX JENSEN, Berkeley Traffic Safety Commission.
 EUGEN P. KABLE, York County Safety Council.
 THOMAS P. KEARNS, Industrial Commission of Ohio.
 K. T. KELLER, Detroit Industrial Safety Council.
 IRA V. KEPNER, Pennsylvania Salt Manufacturing Co.
 E. J. KREH, Public Utilities Section.
 FRANKLIN M. KREHL, Evanston Safety Council.
 C. L. LAFONTAINE, Great Northern Railway Co. —
 FRANK J. LANAHAN, Fort Pitt Malleable Iron Co.
 JOHN LAUFMAN, Meat Packing, Tanning & Leather Industries Section.
 SIMON LAZARUS, Safety Council, Columbus (Ohio) Chamber of Commerce.
 JOSEPH LILICH, Rochester Safety Council.
 DR. R. M. LITTLE, New York Department of Education.
 G. O. LOCKWOOD, Petroleum Section.
 J. E. LONG, The Delaware & Hudson Railroad Corp.
 W. R. LOVE, Safety Div., Birmingham Chamber of Commerce.

Officers and Directors

A. E. LUNDSTADT, Delivery, Taxicab & Bus Section.
 THOS. H. MACDONALD, United States Department of Agriculture.
 L. T. McARTHUR, Peoria Safety Council.
 MILLER McCLINTOCK, Harvard University.
 T. J. McKENNEY, Illinois Steel Company, South Works.
 A. D. McWHORTER, Safety Div., Memphis Chamber of Commerce.
 H. T. MARTIN, Fisk Rubber Company.
 J. O. MARTIN, Employees' Publication Section.
 F. W. MATSON, Minnesota Safety Council.
 E. J. MEHREN, Portland Cement Association. —
 T. O. MEISKEN, Power Press Section.
 WM. G. MYZGER, Mining Section.
 I. W. MILLARD, Accident Prevention Equipment Manufacturers' Section.
 HAROLD L. MINER, E. I. duPont de Nemours & Co., Inc.
 HENRY J. MINEUR, Elizabeth Safety Council.
 LAWRENCE M. MOORE, Eastbay Safety Council.
 R. B. MORLEY, Industrial Accident Prevention Associations.
 JOHN A. OARTEL, Carnegie Steel Company.
 GEORGE C. A. OPP, The Detroit Edison Company.
 LEW R. PALMER, Equitable Life Assurance Society.
 JOHN C. PARKER, Brooklyn Safety Council.
 DAVID A. PATTON, Newark Safety Council.
 C. E. PETTIBONE, American Mutual Liability Insurance Company.
 GEN. GEORGE B. PILLSBURY, War Department.
 J. B. POWER, Seattle Traffic & Safety Council.
 C. E. RALSTON, Western Pennsylvania Safety Council.
 ALBERT S. REGULA, Industrial Relations Counselors, Inc.
 LT. COL. HENRY A. RENINGER, Lehigh Portland Cement Company.
 MARINUS RITER, Paterson Safety Council.
 G. E. SANFORD, General Electric Company. —
 HENRY G. SCHAFFNER, Erie Safety Council.
 T. A. SCHENDEL, Food Section.
 ROBERT L. SCHMITT, Louisville Safety Council.
 H. V. SCHREIBER, Transit Section.
 HARRY A. SCHULTZ, United States Steel Corporation.
 CHARLES H. SCOTT, Bureau of Safety, Inc.
 LESTER D. SEYMOUR, Aeronautical Section.
 EARL S. SHARTZER, Utica Safety Council.
 RAY H. SHEETS, Madison County Safety Council.
 DR. L. A. SHRODY, Bethlehem Steel Company.
 ERNEST L. SIMMONS, New Haven Safety Council.
 LEE E. SKILL, Cleveland Safety Council.
 C. W. SMITH, Standard Oil Company (Indiana). —
 WALTER DENT SMITH, Delaware Safety Council.
 R. T. SOLENTON, Elliott Service Company.
 E. C. SPRING, Lansdale, Pa.
 GEORGE R. STURTESS, Safety Bureau, Buffalo Chamber of Commerce.
 LUCIUS S. STUBBS, United Railways & Electric Co.

8 *Twenty-third Annual Safety Congress—National Safety Council*

DR. F. M. SULZMAN, Troy Safety Council.
ALFRED H. SWAYNE, General Motors Corporation. —————
CLARENCE P. TAYLOR, Massachusetts Safety Council.
ARTHUR M. TONE, Consulting Marine Engineer.
W. W. TRENCH, Schenectady Safety Council.
W. D. TURREVILLE, San Antonio Safety Council.
J. A. VOSS, Metals Section.
H. A. WALKER, Rubber Section.
GEORGE H. WARFEL, Union Pacific Railroad Company. —————
DR. CASSIUS H. WATSON, American Telephone & Telegraph Company.
HARRY M. WERNER, Illinois Bell Telephone Company.
ALBERT C. WHITE, JR., Springfield Safety Council.
S. E. WHITING, Liberty Mutual Insurance Company.
A. W. WHITNEY, National Bureau of Casualty & Surety Underwriters.
W. H. WINANS, Union Carbide & Carbon Corp. —————
DR. C.-E. A. WINSLOW, Yale Medical School.
HARRY WISE, SR., Chattanooga Safety Council.
J. M. WOLTZ, Youngstown Sheet & Tube Company.
W. E. WORTH, International Harvester Company. —————
E. J. ZAUFF, Safety Bureau, Duluth Chamber of Commerce.
EARL W. ZIMMERMAN, Safety Div., Syracuse Chamber of Commerce.
J. B. ZOOK, Cement Section.

TWENTY-THIRD ANNUAL SAFETY CONGRESS
NATIONAL SAFETY COUNCIL



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, asbestos, 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 aluminosilicate 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 abrad 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-existent 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 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.

Attention 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.

aining 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 widely 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 alkalis 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 silicosis, 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

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, the mine of Joplin, Missouri; and later, in 1921, the Public Health Service initiated 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 great investigations.

Briefly, these methods of study may be divided as follows: (1) examination to gauge 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 hazard; (3) record of the nature and severity of the disabling illnesses; (4) analysis and detailed study of the occupational environment; (5) occupational fatality 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, arsenic 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 intensive study of the health of anthracite coal miners was completed.

These six dust studies showed that the workers in the granite cutting plants 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, the extent and severity of the pulmonary damage. Anthracite coal miners died from dyspnea 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 pneumonia. Cement workers showed some signs of early pneumoconiosis with excess of diseases of the upper respiratory tract. On the other hand, workers in cotton cloth and silverware manufacturing plants and municipal street sweepers showed negative for respiratory conditions and other illnesses when compared with general industrial population.

Rock Drilling. For five years, the United States Bureau of Mines studied lead 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 noted as having silicosis, not including those diagnosed as having tuberculosis. The men diagnosed as having first-stage silicosis had worked an average of 6 years, but those men starting in the mines after 40 years of age worked an average of only 3 years.

The work of rock drilling in subway and tunnel construction in New York is in some respects similar to that of some of the activities in the hard rock mining, at least as 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 298 rock drillers, blasters and excavators showed 118, or 39 per cent of the men had silicosis in various stages of progression. 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 plotted 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.

Bituminous 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 bituminous 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 clinicoradiographic 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 aluminum 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, Keister, 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 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, Messers. 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 per cent of quartz in the dust. The talc was a hydrous calcium-magnesium silicate, containing 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 100,000 workers engaged in the mining, quarrying and manufacturing industries in this country in which an exposure to silica dust to a harmful degree is involved. 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 a 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 1.88% 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 of 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 a 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. An example of such a procedure is the possible use of a metallic or other type 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, a 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 shorn 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 cutting 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 a high figure of 45 million particles per cubic foot. In the weaving of asbestos, it has been possible to reduce the amount of dust in the air by wet weaving one-fourth of the amount present when the process is conducted by dry methods. Another example of this procedure in abating dust is the use of a spray of water

in leyner 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 on by the Public Health Service. For example, in the granite study already referred to, it was found that the breathing level of about 10 million particles per cubic foot (1.5 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:

TWENTY-THIRD ANNUAL SAFETY CONGRESS
NATIONAL SAFETY COUNCIL



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

*Chairman—C. L. LAFONTAINE, Great Northern Railway Co., St. Paul, Minn.
First Vice-Chairman—H. A. PARISH, Chicago & North Western Railway, Chicago.
Second Vice-Chairman—W. H. FALLING, 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. LaFontaine, 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

pacts 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-scrappers 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.....	3,800	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.

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.

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 Quillian, 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-