TRANSACTIONS

26th National Safety Congress

NATIONAL SAFETY COUNCIL, Inc.

KANSAS CITY, MISSOURI
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Foreword

THE Transactions of the Twenty-sixth National Safety Congress, 1937, are published by the National Safety Council in two volumes. This, the first, contains the general, the special subject, and the Industrial Section sessions. The second volume contains the sessions of the Child Education, Home Safety, Street and Highway Traffic, Commercial Vehicle and Transit Sections.

All industrial members of the Council automatically receive Volume I. Volume II is sent to members believed to be interested chiefly in the sessions it covers. Other Council members, however, may obtain it upon request.

Many members have found it worth while to distribute copies of the Transactions to supervisors, foremen, and others in an administrative or supervisory position who may make practical use of them for reference purposes. The following quantity prices are quoted on extra copies: 1 to 10 copies of the large volume (Volume I), $2 each; 11 copies or more, $1.75 each; copies of the smaller volume (Volume II), 75 cents each.

THE Transactions are published as a condensed record of the proceedings at the National Congress. The papers of each session or division of the Congress have been edited carefully to eliminate extraneous matter and to abbreviate the less essential portions because of space limitations. Thus the material herein presented is not a verbatim report of all the speeches presented at the Congress, but rather an abridged version made as compact as possible, yet without injury to the technical aspects of any address. The original manuscripts are on file in the Council's Bureau of Information, where they are available for additional reference. Where illustrations were sent by the speakers to the Council, these also are on file.

The National Safety Council at its Congresses seeks to eliminate from discussion matters which are not pertinent to the aim of the Congress or which are contrary to Council policies. It cannot accept responsibility for the views expressed either in the papers presented or in the discussions based upon the papers.

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Council Purposes and Policies

The conservation of human life is the basic purpose of the National Safety Council.

The Council works toward this end through a continuous campaign of accident prevention that is nation-wide in scope, applies to all types of hazardous activity, and directly or indirectly reaches the entire population.

Recognizing that improvement of health conditions and the prevention of vocational diseases in industry are closely allied with accident prevention, the Council is also active in these fields.

The National Safety Council is a non-profit, non-sectarian, non-political organization.

It has approximately 5,000 members, representing every state in the Union and many of the Canadian provinces. There are about 400 foreign members. Included in the membership are industrial corporations, firms, individuals, public officials, schools, chambers of commerce, clubs and civic organizations. About 70 per cent are industrial concerns, including the large steel companies, the oil companies, most of the railroads in the United States, the automotive industry, and others of outstanding importance.

Origin and Growth

The history of the Council begins with the first cooperative Safety Congress held under the auspices of the Association of Iron and Steel Electrical Engineers in Milwaukee in 1912. As an aftermath of this Congress the National Safety Council was organized in New York in 1913 with 14 members. During the first year the membership increased to 971.

These safety pioneers based their program on the assumption that accidents are unnecessary and avoidable. They began to develop the principles and the materials to make accident prevention possible.

The continuous growth of the Council and expansion of its activities attest the soundness of these principles. Every field in which a coordinated program has been applied offers striking examples of the possibilities of accident reduction.

Results of Organized Safety

Since the National Safety Council was organized in 1913, the national accident death rate in all fields except motor vehicle has been reduced 30 per cent. Because the traffic field does not offer the possibilities of control that are found in the industrial field, the motor vehicle accident problem continues to be a serious one. While there was a slight decline in fatalities in 1932—the first decrease that had occurred since the advent of the automobile—increases have occurred in succeeding years, with an all time high in 1936.

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 cases 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. The results of safety work in this field have often been phenomenal.

For example, the steam railroads have reduced the accident rate among employees 74 per cent since 1923. A group of the largest steel industries has cut its accidents 90 per cent since 1913. It is not uncommon for an industrial establishment to complete an entire year without a single disabling injury among its employees.

In the face of such reductions the psychology of accidents is changing. Accidents are becoming out of date both from the viewpoint of the employer and the employee. They are being recognized as a reflection on the efficiency of the plant.

Looking Ahead

The universal character of the safety problem makes it natural that the idea which has been fostered in the United States should reach into other countries of the world. Organizations similar in purpose and activity to the National Safety Council have been formed in many countries. Council posters have been widely copied for foreign use, and several National Safety Council publications have been translated into other tongues.

The National Safety Council is still young, but it has made amazing progress during its short lifetime. These achievements offer inspiration and incentive for continuing its humanitarian efforts.

* * *

Objectives

The purposes and policies of the National Safety Council are not always understood by those who are not in close touch with the Council's work. As a concise presentation of the Council's objectives, the following has been approved by the Executive Committee as an official statement of policy:

"The National Safety Council's objective is the elimination of accidents to men, women and children, as being deplorable, unnecessary and wasteful. It seeks memberships, cooperation and contacts to insure that its services may provide for instrumentalities and finances to accomplish this objective.

"Through education it seeks to demonstrate that the safe way is the right way and the best way, from the standpoint not only of human satisfaction but of social efficiency and economy. It seeks those ways and means for safety that satisfactorily fit into the practical affairs of life.

"Its financial policy is to return in service all moneys received, so operating without profit, and to undertake only those activities which can be assured of reasonable permanence. Much of its administrative personnel consists of volunteer workers.

"The National Safety Council holds itself open to give fullest and most cordial cooperation to all individuals, industries, organizations, communities, states and nations that are in accord with the principles and objectives of the organization, and the National Safety Council likewise asks and seeks cooperation from all these in carrying out its purposes."

Annual Meeting of Members

MONDAY MORNING SESSION

October 11, 1937

The Annual Meeting of Members of the National Safety Council at the Twenty-sixth National Safety Congress, assembling in Kansas City, Mo., was called to order by Dr. C. H. Watson, President, who presided.

The invocation was delivered by the Rev. Walter H. North, Pastor, the Country Club Congregational Church of Kansas City.

The secretary reported that a quorum of members entitled to vote was present in person or by proxy, and the formal roll call was dispensed with.

The chairman then introduced D. L. Fennell, President of the Kansas City Safety Council, who welcomed the delegates in behalf of the Kansas City Congress Committee.

Address of Welcome for Kansas City Safety Council

By D. L. FENNELL

President, Kansas City Safety Council

The Kansas City Safety Council in the Heart of America, welcomes you.

This is a welcome in which every phase of Kansas City's varied interests sincerely joins.

Our schools, churches, women's organizations, civic clubs, fraternal societies—in fact, I feel I can speak for every citizen of this community—bid you welcome, because we realize that the ideals of the National Safety Council tend to make a happier life for all of us.

The Kansas City Safety Council, in welcoming you this morning, is realizing a hope of which we have long dreamed, and wishes to express appreciation to you for bringing your twenty-sixth Congress here, not because it is merely another large Convention, but because it presents a splendid opportunity for Kansas City and this Mid-West area to learn from the assembled delegates things that will make possible better safety records.

We are aware that the eyes, ears and minds of the entire nation are focused upon this Congress in Kansas City, with prayers for the success of its accident prevention program. Our Country wants this Congress to succeed in its purpose. Why?

Because America today realizes, as never before, the terrible significance of its huge accident losses. Because America knows today, as it has never known before, that its homes and its dear ones are threatened with their very lives.

This wonderful Safety Congress has the power, organization and unity to accomplish great things. The American people expect and have the right to expect that from this Congress will come a program adequate for their protection against death and tragedy by accidents.

Kansas City, on the evening of October 6, completed a year in which we had no fatalities to children 15 years of age and under, from motor vehicle accidents. This is a record of which we are extremely proud. The record as to motor vehicle fatalities to persons above this age is not such as we desire, but our record for 1937 shows an improvement in this respect over the same period for 1936.

With all public officials and civic organizations cooperating with the Kansas City Safety Council, we have made plans to the best of our ability to see that your visit with us is an enjoyable one.

Industrial Dusts

WEDNESDAY MORNING SESSION

October 13, 1937

The meeting was called to order by Chairman A. S. Regula, Executive Secretary, Industrial Relations Counselors, Inc., New York City, and Vice-President for Engineering, National Safety Council, who introduced the speakers.

What Industrial Dusts Are Harmful? Why?

By SENIOR SURGEON R. R. SAYERS

Chief, Division of Industrial Hygiene, U. S. Public Health Service

While dusts exist everywhere in the atmosphere, it has been recognized for centuries that workers in certain dusty occupations are less healthy than those not so exposed. The number of persons exposed in dusty occupations comprises one of the largest industrial groups. The occupational diseases of workers in dusty atmospheres have been found to be due to entrance of dust into the system by inhalation, by ingestion, by direct absorption through the skin, by irritation of the skin, or by a combination of the foregoing.

The suspensions of particulate matter in air have been broadly termed dusts, fumes, and smokes. Such a classification is necessarily arbitrary, since the line of demarcation between them is not very sharp, and the chief differentiation is based on the size of the particles. Investigations by the Public Health Service in dusty industries[1] revealed that about 70 per cent of the dust particles examined were between 1 and 3 microns in size, only about 20 per cent were less than 1 micron, and the median size was 1.3 microns. Industrial dusts are mainly less than 10 microns in size. However, fibrous dusts in the air, such as asbestos, have been found to contain particles as large as 200-400 mircons in the greatest diameter.

While, generally speaking, according to Collis, dusts are more injurious as their chemical composition differs from that of the human body, or from the elements of which the body is normally composed,[2] it is difficult to establish a comprehensive definition for *toxic* dusts. Sollmann,[3] after analysis of various definitions for poison, felt that it is very difficult to give a definition which will not be ambiguous in some cases, but believed that the following covers most of the points which must be considered in classing a substance as such:

> "A poison is any substance which, acting directly through its inherent chemic properties, and by its ordinary action, is capable of destroying life, or of seriously endangering health, when it is applied to the body, externally, or in moderate doses (to 50 Gm.) internally."

Some dusts are known to be poisonous, while others, in the concentrations usually encountered, are comparatively harmless. However, it may be stated that *breathing* dust in high concentration is not desirable.

According to Fairhall, the damage arising from the inhalation of toxic dust may be either local or remote, and depends upon whether the material is a protoplasmic poison, whether it is caustic in reaction, or whether it is absorbed into the blood stream and carried to other centers which are in turn affected.[4]

It is now well established that exposure to certain kinds of dusts, such as those containing considerable quantities of free silica, has increased the morbidity and mortality rate from respiratory diseases; while metallic dusts, such as lead and its compounds, have been associated with general systemic poisoning.[5] Dusts may be swallowed with saliva, water, or food, and direct poisoning has been traced to absorption by this method; other dusts may act as irritants and produce affections of the skin, irritate mucous membranes of nose, eyes and throat, often causing inflammatory diseases of these organs.[6]

Some inorganic dusts are able to penetrate the deep lung tissues and are sufficiently insoluble to be retained there. Some of these may be active in the human tissues, causing definite and permanent injury, while others are inert and may be retained for years, apparently without serious damage; some are gradually absorbed without causing pathological changes.[7]

All inhaled particles are soluble, at least to a small extent. If harmless, cell activity is stimulated so that phagocytes remove the dust. If the solute is toxic, the viability of the phagocyte is affected and an ineffective accumulation results. At the same time, further solute may diffuse into neighboring tissues, setting up an irritation and subsequent fibrosis. The nature as well as the solubility of the solute is an important factor, but of two substances of approximately equal toxicity, the more soluble form causes the greater damage. However, substances of such low solubility as silica may ultimately produce extensive injury.[4]

Kettle has stated that harmful dusts, if inhaled into the lungs, may activate a latent tuberculous infection; they may exaggerate an active tuberculous lesion or a coincident infection. If sufficient quantities of a harmless dust are inhaled, some of it remains in the lungs and causes a mild degree of fibrosis merely through mechanical irritation, but such fibrosis is never sufficient to interfere with the function of the lung.[8]

Some writers state that while the influence of nonpoisonous dusts on health is a debatable subject, abnormally high death rates from bronchitis and pneumonia are sometimes attributed to chronic exposure to nontoxic dusts. Large amounts of dust are occasionally found in supposedly normal lungs, at autopsy.[9]

According to Drinker, there are four different types of reaction produced in man by the inhalation of dust. The first and most important are the pneumoconioses, such as silicosis and asbestosis, which cause specific lung pathology and often are followed by pulmonary tuberculosis. The second type of reaction is caused by toxic dusts like lead, cadmium, and radium. A third type of malady follows the inhalation of finely divided metallic fume particles such as zinc oxide, and is known as metal fume fever. The fourth reaction, allergic in character, is caused by breathing organic dusts such as pollen and certain types of pulverized wood and flour. In all four cases the sole cause of the disability may be dust inhalation, but the reactions from toxic dusts result from swallowing as well as from inhalation.[10]

For various reasons it is difficult to set up an absolute classification for dusts. Opinion is rapidly changing regarding so-called inert or harmless dusts and further investigation may prove some of them to be injurious. Some dusts may have both a toxic and an irritant action; while on the other hand, the poisoning resulting from exposure to a dust may be the combined effect of more than one mode of entrance into the body. However, the following classification of dusts, according to physical characteristics and physiological effect, is used for convenience.

I. Organic Dusts

Organic dusts are those which contain carbon, and were originally supposed to come from organized substances derived from animal or plant life. Living dusts come under this classification, and are thought to be of the same order of size as industrial dusts, with which they are frequently associated. Bacteria are usually between 0.5 and 3 microns, except in a few cases, such as the anthrax bacillus, which ranges from 1 to 1.25 micron in breadth and 4.5 to 10 microns in length and 10 or 12 microns in diameter. However, it is possible that the larger and heavier varieties, like the larger and heavier dust particles, settle due to gravity, and do not remain suspended in the air.

Many thousands of organic substances, carbon-containing, are made synthetically by chemical processes, such as dyestuffs, explosives, etc.

1. *NONLIVING ORGANIC DUSTS.* As the name implies, these are comprised of nonviable particles, which may or may not be inherently toxic or irritant, but which nevertheless produce untoward effects in the human organism. "Allergic" dusts, or those to which only certain persons are or may become hypersensitive, with resulting asthma, rhinitis, or other disturbances, are included in this classification.

a. *Toxic and/or Irritant.* Toxic or irritant dusts are all organic dusts which produce untoward symptoms, either systemic or local. Those producing local symptoms are usually described as irritant; those producing general or systemic symptoms are termed toxic. A dust may be both toxic and irritant.

In reported cases of injury or death following inhalation of dust from organic compounds, among the chief offenders are paranitraniline, the dinitrobenzenes, chlorodinitrobenzenes, trinitrophenol, and nitronaphthalene. Eye damage due to inflammation of the cornea has occurred among workers exposed to methyl violet dust. The dust from paraphenylene diamine derivatives is particularly irritating and dangerous, causing not only a severe form of dermatitis where the dust comes in contact with the skin, but also producing acute inflammation of the mucous membrane of the respiratory passages.[4] Toxic dusts may be generated during the handling of powdered dyes and in preliminary dyeing operations, particularly the hydro-extractor process, where particles are disseminated in all directions.[11] Coal tar and indigo dyes are substances most frequently used.

Cases of amblyopia have been reported from exposure to inhalation of tobacco dust.[12] It has been found that inhaled tobacco dust exerts a nicotine action on the organism fifteen times greater than that produced by the same quantity of smoked tobacco with an equal nicotine content.[13]

Severe dermatitis is experienced by many workers handling powder containing T.N.T., which is used in making high explosives. Picric acid, which is also used for this purpose, requires drying, and in this latter state has been found to produce a dermatitis. Picric acid is also the oldest synthetic organic dyestuff.[14] Dermatitis occurs among handlers of silk with varying frequency. Salls determined that a rash occurring among workers in a silk factory was due to dust from silk cocoons imported from Africa.[15]

Persons engaged in the manufacture of quinine and quinine preparations suffer from skin phenomena, which occur for the most part on exposed parts of the body, and may be caused by ingestion or by quinine dust, or powder form of the preparation, exerting a direct irritating effect on the skin.[16] Dermatitis due to other vegetable dusts such as vanilla, powdered arnica, pyrethrum, etc., have been reported.[16]

Dental lesions, of occupational origin, have been reported among workers in sugar. The gingivitis caused by sugar dust is classified as purely mechanical, with later-developing caries. Digestive disorders, respiratory conditions, and cutaneous conditions (especially of the face) were also found.[17]

Dock workers, transporters of grain, workers in grain and flour mills, etc. are exposed to dusts during their work. Dusts from cereals may contain many impurities, which may cause an irritating action on the respiratory passages, as well as inflammation of the skin. Digestive disturbances, dental defects, diminution in hearing, and conjunctivitis have been observed among millers, and have been attributed to the dusts to which such workers are exposed.[18]

b. *Allergic.* Many apparently innocuous substances may produce reactions in persons of peculiar personal susceptibility. The term "allergy" is used to describe this condition of hypersensitiveness or susceptibility, and allergic phenomena most frequently manifest themselves in skin reactions. However, they may cause acute reactions elsewhere in the body. When the respiratory tract is involved we have such well known diseases as hay fever or asthma. These diseases may develop as a result of hypersensitiveness to such substances as pollens from plants, horsehair, rabbit's fur, furs, feathers, etc.

For instance, furriers, workers in clothing industries who are exposed to wool dust, etc., may suffer from hay fever or asthma.[19] It is unnecessary for the offending dust to reach the depths of the lungs—giant pollens for example are reported to produce their effect after being caught in the upper respiratory passages. Should such an offending substance be finely ground it could reach the alveoli and as a result probably all physiologic reactions would be accelerated.[20]

In a survey of a plant where resin is mixed, ground, and molded, it was found that 80 per cent of the occupational dermatitis there was due to hypersensitivity to hexamethylenetetramine and formaldehyde contained in the dust to which the workers were exposed.[21] During the first processes of cotton spinning, cotton-strippers are exposed to dust arising from cotton husks and débris, which produces a typical form of asthma.[2]

Ordinary wood dust has been of interest due to its purely mechanical action, but still greater care is required in handling certain kinds, especially woods coming from abroad, because of the essential oils impregnating them, which when freed in the dust may affect the health of the workers concerned. Some of the woods capable of causing skin lesions are Brazil wood, satinwood, teakwood, cumaru or tonka wood, black ebony wood, West Indian mahogany, Japanese tagayasan, coccoloba, chestnutwood, olivewood, California sequoia, etc. All persons who handle these woods are not injured, only those particularly susceptible to the substances they contain becoming affected.[29]

2. *LIVING ORGANIC DUSTS.* These contain particles capable of exhibiting the phenomena of life[2] (especially the property of reproduction or multiplication), such as bacteria and fungi. They are usually found in low concentrations and are associated with nonliving dusts in the air.

a. *Bacteria.* One of the most important among these is the anthrax bacillus, which is contained in the dust from skins, furs, wool, and animal hair, horns, hoofs, bones, etc. This disease may occur in two forms: *cutaneous* (in which the organism affects the skin), and *pulmonary* (when it is inhaled, as in the form of anthrax known as woolsorters' disease).[15]

Cases of tetanus, reported in connection with jute manufacture, were traced to the raw material, the bacillus having been found in the factory dust.[23] Diphtheria, tuberculosis, smallpox, typhoid, or other bacillus-produced diseases, may result from exposure to infected dusts.

Bacterial sensitization can be the cause of any of the allergic diseases, namely, asthma, perennial, hay fever, urticaria, angioneurotic edema, eczema, or migraine headaches.[24]

b. *Fungi.* Dusts containing the mycelia and spores of parasitic fungi give rise to annoyance and discomfort. "Maltster's" itch from the dust alone has been reported. In Provence, reeds used for ceilings are stacked while still wet and undergo fermentation; they become covered with a white powder (a dry fungus of the Mucor family: Sporotrichum dermatodes), which is scattered when the bark is stripped off. This powder is irritating to the skin and mucous membranes. Mycelia and spores of moulds are commonly found to cause rashes: for instance, the black powder coming from macerated sugarcane stalks. Among basketmakers, the mycelium and spores, in the form of a white mould (hyphomycete) from the rhattan canes used, get shaken out when the canes are split, hammered, and cut, causing painful fissures to develop on the skin where they alight.[14]

A form of asthma or spasmodic cough, suffered by cotton weavers and known as aspergillosis, has been considered due to inhalation of spores of a mildew which sometimes occurs on the threads.[29] In a study of silicosis among miners, made by the Public Health Service, a number of cases of typical miliary calcification were encountered. Unstained smears of those cases examined were positive for fungus, two types of Aspergillus fungi being identified. All of the subjects but one were farmers, teamsters, feedmill workers, or residents of small agricultural towns where grain is marketed. Farmers are exposed to fungi in threshing wheat, baling hay, or handling various small grains.[26]

Some other fungus diseases such as actinomycosis and blastomycosis are associated with occupational exposure to dust. The former occurs among workers handling straw, hay, grass, vegetable débris contaminated with mould, etc. Actinomycosis is likely to affect people engaged in commercial handling, storing, and cleansing of grain (grain distilleries, flour mills, grain crushing, breweries, and malting houses, etc.).[24]

II. Inorganic Dusts

Inorganic compounds are of mineral origin, not requiring a living organism to produce them.[27] A number of dusts not usually classed as toxic may, under some conditions, produce untoward effects on the human organism. Classified under inorganic are toxic and/or irritant, fibrosis-producing, and nonfibrosis-producing dusts.

a. *Toxic and/or Irritant.* Toxic dusts are those which are inherently toxic when inhaled, ingested, or otherwise absorbed. Among those which produce systemic poisoning, some of which are also irritant, are the dusts from heavy metals and their salts, such as lead, mercury, arsenic, cadmium, zinc, etc. Irritant dusts are injurious by reason of their strong irritative or corrosive properties.

As a rule, inhaled irritant substances immediately cause a reaction in the upper respiratory tract of such severity that they are prevented from reaching the lungs, although they may cause lung damage by extension of inflammation if the mucous membrane is corroded.[7] Lime, calcium oxide, and the di-chromates are examples of irritant dusts. An inorganic dust may possess both toxic and irritant properties, and the poisoning produced may be the combined effect of more than one mode of entrance into the body.

Of the directly poisonous dusts, the most widely prevalent are those of certain lead compounds, particularly the oxide, carbonate and the chromate. The dust is readily absorbed by the mucous membrane; some dust passes into the stomach and is dissolved by the gastric juice.[6]

According to Fairhall, perforated nasal septum is a common occurrence among workers with bi-chromate dusts.[4] In a study made by the U. S. Public Health Service it was found that continuous daily exposure to concentrations of chromic acid mist greater than 1 milligram in 10 cubic meters is likely to cause definite injury to the nasal tissues.[28] It is believed that a similar concentration of the dust would be equally toxic.

In the case of poisoning from some heavy metals, exposure may be to both dust and vapor. For instance, investigations have shown the safe limit of *total* exposure to lead oxide dust and fumes to be less than 1.5 mg. per 10 cubic meters of air, except for prolonged exposure.[29] In exposure to mercury dust and vapor, it was shown that the incidence of chronic mercurialism increases rapidly with increasing mercury concentration, after such concentration exceeds 2.0 mg. per 10 cubic meters.[30]

Alkalis and metallic oxides are common causes of dermatoses. Lye, potash and lime are known to cause irritation to plasterers, cement-makers, bricklayers, masons, stonecutters, modellers, and metal platers.[16] Ulceration and perforation of the nasal septum occur among workers exposed to the dust of soda ash; systemic poisoning also occurs from inhalation of calcium cyanimide dust.[31]

Cases of dermatitis, scleroderma and cancer are reported to have been caused by exposure to dust of arsenic compounds. Certain aluminum salts are skin irritants and aluminum dusts may contribute to the infection of skin and mucous membranes, through mechanical action.[16]

b. *Fibrosis-Producing Dusts.* The most important of these are the inorganic, slightly soluble dusts which cause fibrous changes in the lung tissues, some of which are serious, and some of which cause little or no disability.[7] So far as is known, no inorganic substances other than silicon derivatives cause more than a very moderate degree of fibrosis of the lung. Moreover, there seems to be no evidence that any other constituent of ordinary dusts can influence so unfavorably a pulmonary infection.[8]

Although other dusts, when inhaled in sufficient concentrations over a long period of time, have been shown capable of producing a pulmonary fibrosis, nevertheless, the pneumoconiosis characterized by nodular fibrosis has to date been shown clinically and experimentally to be associated only with the inhalation of dusts containing free silica.

Since this dust, to exert its harmful action, must enter the finer divisions of the lung, the particle size of the atmospheric dust may bear a definite relationship to the injurious effect produced. The silica must be present in the air in particles small enough to enter the finer air spaces and of such dimensions that the phagocytic cells may engulf them. The greater majority of particles found upon microscopic examination of the lung fall within the limits of from 1 to 3 microns.[31] Examples of siliceous dusts are granite, quartz, sand, pumice, slate, etc.

In a recent study among anthracite miners, the correlations between exposure to dust (which contained silica) and the evidence of constitutional changes left little doubt as to the etiological significance of the dust in the air breathed. Like correlations were found between the silica exposure and the extent of pulmonary changes.[32] When the inhaled dust consists of silica combined with bases, silicates, some degree of change in the pulmonary tissue may result. In this respect asbestos dust seems to be unique among silicates in the prevalence and severity of the disease it causes.[33]

The chief distinction between silicosis and conditions due to simple reactions caused by other dusts is the active proliferative reaction in the tissues which results in progressive nodulation. Silicosis, when once established, strongly predisposes the lungs to infection, especially with the tubercle bacillus. Chronic interstitial pneumonia, chronic bronchitis, and emphysema are frequent complications of advanced degrees of silicosis.

The relation of the acute respiratory infections to the reaction due to dusts other than free silica has never been established, though a heightened incidence has often been shown statistically in workers in dusty trades. It is fairly certain that a dust damaged lung, whatever the cause, fares much worse if an acute infection does supervene upon it.[illegible]

In a study conducted by the U. S. Public Health Service among marble finishers in Vermont, it was found that marble dust when inhaled in the concentrations found in the examined plants produced a mild, bilateral, linear fibrosis in some cases, but no serious lung changes were noted and there was no disability due to the dust, even after years of exposure.[illegible]

c. *Nonfibrosis-Producing Dusts.* These are inert, that is, they do not cause fibrous tissue to be produced, but may become encapsulated or lie free in the tissues; or they are absorbed without production of fibrous tissue. Included among them are alundum, coal, corundum, emery, limestone, magnesite, marble, plaster of paris (gypsum), and polisher's rouge.

Dust Control

Engineering and medical control are the two most important factors in combating the industrial dust hazard, and are to a large extent complementary.

Engineering Control. As Lanza[23] has stated in a recent paper, "It is a basic principle in dealing with a dust hazard that the dust should be attacked at its point of origin and thus prevented from being disseminated into the atmosphere." After the dust has been spread throughout the air it is difficult to deal with it, and reliance must be placed on individual protection, which is never wholly satisfactory.

Lanza further cites various methods used in controlling dust. These will be reviewed but briefly, since a paper dealing with the subject of dust control in detail, will follow on this program.

Dust may be entrapped at its source by suction devices and thus removed and collected. Familiar examples are exhaust hoods in grinding operations, and the devices used in rock drilling.

Generally speaking, the exhaust ventilation method, where applicable, is to be preferred in controlling a dust hazard. Water may be used to entrap dust and prevent its dispersal, and under certain circumstances it may be of advantage to combine the use of water and the use of suction. Sometimes a dusty process can be completely enclosed in a sealed room or compartment. It must be remembered, however, that any mechanical device of this kind offers adequate protection only if it is properly designed, installed, and maintained.

A great deal of attention has been given the subject of individual protection from dust, and there are many types of respiratory protective devices now available. These are generally of two types: those which provide fresh air from an uncontaminated source and those which rely upon a filtering medium for removing dust from the air breathed. Where the use of such a device is indicated, only one of the types approved by the U. S. Bureau of Mines should be used. As a rule, it may be said that masks, respirators, or other such protective device should be used only where exposure to the dust is intermittent and brief, or where some unusual condition makes a more adequate dust control impracticable.[illegible]

Where bacteria or other living dusts in the air are associated with a process, sterilization methods such as increased temperature, ultraviolet radiation, and chemicals like chlorine or other bactericidal substances, may be of use. Pasteurization temperature (about 140° F.) will kill most organisms except those bearing spores. Steam disinfection is used for horsehair, and proves to be practicable if the temperature does not exceed 230° F. Wool fibres, however, lose their elasticity by steam disinfection, and the "Duckering" process now used in England includes soaking of the wool in a formaldehyde solution, and drying in a current of air at a temperature of 160° F.[12] There are few occupations in which there would be a sufficient concentration of dead bacteria to cause untoward effects in man.

In the case of dusts producing external irritation, auxiliary protective measures may include the use of protective clothing, gloves, goggles and aprons; as well as protective salves, ointments, or other compounds to delay or diminish the irritant action. General rules for hygiene and good housekeeping should also be observed.

Medical Control. Equally important, and closely interrelated with the engineering phase, is medical control of occupational hazards. In addition to directing the proper placement of new workers, and guarding the health of all employees, medical control is a check on the efficacy of the engineering control methods already instituted, or a measure of the need for new protective devices.

It has been stated that "Industry has found that the best way to treat industrial injuries and illness is to prevent them,"[illegible] and medical control, through preemployment and periodic physical examinations, is one of the most important factors in such prevention.

The preemployment examination is made to determine the employee's physical and mental fitness for work. It serves to disclose the presence of any contagious disease, reveals any minor physical defects which might later become serious, or whether the examinee's condition precludes his employment in certain or in all types of work. It should be remembered that such preemployment examinations are not to be made for the purpose of eliminating an employee, but rather for allocating him to the type of work for which he is physically suited. A worker should be given employment unless totally unfit, or unless his disability, even though slight, would cause him to be a hazard to himself or his associates. Furthermore, the practice of preemployment examinations should be extended to include executives and officials of industrial organizations.

"The purpose of periodic physical examinations is to secure and maintain physical fitness and thereby lengthen work spans."[illegible] Reexamination of employees sometimes results in the discovery of defects and disabilities which were not observed at the time of employment. In such cases, an occupational adjustment should be made to provide continued employment, but remove the risk of permanent injury.

Reexamination of employees is required by law in certain occupations in which the handling of poisonous or otherwise deleterious substances may result in the contraction of disease.[illegible] Since some occupational diseases tend to clear up and recur, records of previous occupations should be included in the physical examinations. The frequency of examinations should be determined by the medical director, unless otherwise specified by law. Those exposed to known occupational disease hazards may have weekly or monthly examinations.[illegible]

"It should always be kept in mind that the basic principle of physical examinations in industry is to keep men on the job and not allow the physical examination to be merely a weeding out process."[illegible]

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The Engineer's Part in Eliminating Dust Hazards

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When one realizes that control of the dust hazard depends upon the combined contributions of the physician and the engineer, he appreciates that the solution requires scientific treatment. By scientific treatment I mean the technical analysis of the hazard to discover the causes which contribute to injury or ill health, and the development of control methods which obey physical law and physiology, and which will be directed at causes that admit of most immediate and economical treatment.

That goes for handling the dust hazard in a given plant. It goes double for acquiring knowledge to the end that the whole problem may reach ultimate solution. Right now our knowledge of the problem is in big chunks, loosely put together and largely empirical.

There are estimates only to judge the magnitude of the dust health problem, and it is so closely associated with other health problems that a clean-cut estimate of it alone is impossible. We do know that it is great in the aggregate, and for the individual plant it may be very bothersome and expensive.

What actually makes quartz dust cause silicosis is not known. It does, so the air breathed by workmen must not contain harmful quantities of respirable quartz dust. Inexpensive methods for making the air clean are still in the realm of dreams. Much work must be done to know more about silicosis and more how to make atmospheres safe *inexpensively*. As an accident prevention job, dust control lies almost entirely within the administrative responsibility. The control measures are capital expenditures of considerable size.

A plant with a dust hazard is sick, it needs an expert diagnosis and scientific treatment, which may include expensive major operations. Home remedies are seldom much good, and supervision and employee safety consciousness alone cannot accomplish anything. There may be observed in countless shops installations for exhausting dust which are derisively called "tin knocker" jobs in which the horsepower dissipated is out of all proportion to the air-borne dust moved. Tonnage efficiency of material moved may be the proper yardstick for pneumatic conveyors but if the material to be moved is air, contaminated with nearly weightless particles of dust, the entire health hazard can lie in the half of one per cent of material not moved.

I do not mean that unless a dust supression job was engineered it can be no good. There are many good installations that were never figured at all but grew like Topsy. The resulting freedom from dustiness was so satisfactory that efficiency held little interest to the owner. This is exceptional, however, and I offer the opinion that dust suppression jobs should be engineered.

A dust-suppression installation is a safety device, designed and operated to provide protection against possible disease and provide a sense of security which must be absolute. Its safety is not rushing air and rattling chips but a minimal residual dustiness. There is no more pathetic defeat for a dust control job than to find faith in its effectiveness so low that workers must wear respirators to find the reasonable safety that was expected from the hoods, ducts and fans.

Diagnosis and Control

Let us examine some of the features by which we recognize this dust hazard problem, leaving out the socio-legal aspects.

In order to develop more fully the engineer's place in this dust control program, it seems desirable to separate as sharply as we can the diagnostic considerations from those which deal with control. In the first compartment we can place all the analytical components which describe the hazard and its exposure, the probability of its producing ill health and all the rest of the medical and industrial hygiene facts which make out a case against the existing dust. In the second compartment place the knowledge of physics and engineering necessary to plan the dust control program and so design it that when installed its performance follows prediction that the probability of industrial disease is reduced to insignificance.

The Industrial Hygienist

Our first feature of interest would naturally be the specific and relative toxicity of silica, silica-bearing and other dusts which make up the dust health hazard. Much might be said to advantage about the quality and quantity of hazard in many dusts. The acquiring of this knowledge has been, and must remain a medical problem. It involves gross and microscopic pathology and x-rays, and experimental animals. Engineers do not talk that language. Industrial hygienists do; they are a happy combination, half doctor and half engineer. Many of them are quite capable of handling the dust health hazard in all its phases of investigation and control. For the purpose of this discussion I throw their interest in with the doctors.

I want to go so far in my opinion as to state that the engineer should not attempt to define the quality of health hazard in a given plant or industry, nor should he establish threshold limits of safe or permissible dustiness. This may be debatable, but I shall contend that the engineer who writes the specifications of hazard and dust tolerance is really an industrial hygienist, and is using a very much broader knowledge than engineering alone.

In the first case the quality of the health hazard is an opinion arrived at after studying all the environmental conditions including the general sanitation, occupational analysis and a scientific analysis of the dust exposures. In the exploration of dust exposures, the nature of dusty operations must be viewed from physical, chemical and mechanical aspects, the determinations of dustiness must be not only counted and classified by particulate sizes, but chemically and mineralogically analyzed. The plant layout must be studied with respect to dust production and distribution, and the housekeeping and existing dust control equipment evaluated. The presence of specific hazards, such as toxic gases, abnormal temperature and humidity conditions, etc., must be explored for their complicating effect upon the whole picture. This is distinctly an industrial hygiene job, and some of the most critical data requires only medical viewpoint. This is absolute in the case of tuberculosis study and the qualifying of men for employment.

So far, not one atom of engineering to suppress dust is involved. It is entirely analysis of hazard. The diagnosis must be that the dustiness is hazardous to health or that it is safe. If it is hazardous, it must be brought down to a specified residue. If it isn't, leave it alone. On the second point, if the hygienists can not specify threshold limits graduated upward for relatively less hazardous dusts, let the engineer not worry about it. The diagnosis is dust which is harmful and too much of it. The remedy is control of the dust. The engineer designs controls which will produce the lowest practical residual dustiness. He should not attempt to write his own specifications of threshold limits or permissible dustiness. This may be an important goal in the study of dust health hazards.

Safe Limits

At the present time the medical men and hygienists believe that quartz dust is safe below five million particles. They seem willing to graduate upward to 20 million for medium silica and 50 million for low silica percentages. Five million particles is virtually dust free, and is very difficult and expensive to achieve and maintain. The declaration of safety of the installations must remain in the hands of the medical and hygiene groups in whose hands now lies the responsibility for determining the hazard.

We now enter the chapter of our discussion intended to demonstrate that dust control is an engineering job, that it must be given scentific treatment, not guess work, applying engineering methods which are based upon a knowledge of physical law, the behavior of dust, the performance of air-moving machinery, etc.

Prerequisite Knowledge

Let me recite briefly, a few of the things which, in my opinion, the engineer should know to do this job correctly. He must know how to make a survey. Surveys depend upon sampling, and sampling is not a catch-as-catch-can proposition. It involves the place, the time, the frequency, the amount in a sample, and the number of samples so that maximum, minimum and average data mean something, so that credibility can be given them.

For the type of sample involved he must know how to weigh or count respirable dust, as distinguished from large masses of non-respirable dust which complicate the picture. He must know how to observe the sources of dust floods as distinguished from conditions of normal dustiness. He must know the sources of dust and the principles involved in the dispersion of dust. He must determine how much dust enters the problem because it is part of the material, and what dust is created in the process by the fracturing of the material.

Any less survey cannot tell the engineer what his task of dust control is. To visualize that task intelligently he should know the physics of Brownian motion, laws of resistance to the motion of particles moving in air, both when the air is in turbulence and for stream-line motion. He should know terminal velocities, movements due to centrifugal motion; flocculation and the effects of air motion and the effects of humidification on it. He must know all about the difficulties of wetting and what is known about overcoming these difficulties. He should know the several electrical phenomena which bear upon dust behavior.

Those are all principles of physics which explain the behavior of dust and upon which engineering practice must be based. They must be understood and be taken into account. Dust control is not a matter only of general ventilation; the engineer must study the production as well as the dispersion. The problem should be analyzed to determine the applicability of segregation, enclosure, wetting, local exhaust and general ventilation.

In some instances, substitution of non-hazardous material, or non-dust-producing operations may have specific application, and they should be explored first. This implies plant engineering. I am convinced that many bad installations are bad because plant engineering was not used. In the designing of exhaust systems installed to capture the dust at the points of generation, the physical behavior of air moving toward hoods and in ducts must be known, and that knowledge used. Each system must consist of collection hoods, piping, air-cleaning plant and a source of suction. Before selecting a hood for a job the engineer must know dust dispersion by dynamic projection as well as dust dispersion by air currents, and design the hood accordingly.

Knowledge Needed

The aero-dynamic characteristics of suction hoods appear to be little known because little thought was given to them in designing thousands of hoods which can be found everywhere in industry. All the possibility for entrapping dust and much of the efficiency of the system lies in this factor. Air velocity, static suction, and rate of air flow are all related, and they must be known. It is essential to use high velocity of air in certain types of exhaust systems to entrap dust projected at high velocities as in the case of a granite surfacing machine, and low velocities must be used in others, as in the case of cleaning asbestos fibre of dust to prevent wasting material.

Quantity of air and its velocity must be determined, then the piping should be designed to take into account the behavior of air-flow through pipes at low and high velocities. Where the problem is complicated by the large sized particles which go along with the fine dust, how these behave must be taken into account. Pressure losses are very important elements in the design of an exhaust system. Loss at the hoods, loss at the bends, and loss in the ducts must not be guessed at. Pipe design must take into account the gage of the metal and reinforcing to withstand pressures and erosion.

The selection of a fan and its motive power is a matter of calculation, not guess work. Power consumption in the system is calculable, fans follow certain laws, so the engineer must know the behavior of axial flow, propeller type, radial flow, paddle wheel and other fan performance.

More physics and engineering calculation goes into the air-cleaning apparatus. The selection of gravitation, inertial or filtration method depends upon what the dust is, the calculation for any methods requires knowledge of discharge through stacks, the determination of sizes of settling chambers; the behavior of cyclones. The use or non-use of a filter, and if so, what type, how it should perform, how big it should be, what kind of resistance and how much each kind offers, to say nothing of their proper location with relation to cleaning, accessibility, etc., are all items for accurate engineering determination.

Apparatus to check the behavior of installations must be known and used. Performance cannot be left to guess work. Supplying sufficient air to be exhausted is part of the problem. The same may be said of heating.

Do I give the problem too severe a build-up? I think not. Remember these two things:

1. You are dealing with hazardous material so small in size and so little of it by weight that it is as invisible as the air that bears it.

2. Physical laws involved in the behavior of dust and air do not permit inexpensive methods of control. I am acquainted with budgets set up for this purpose which amount to more than a quarter of a million dollars, and I know of many where 60 to 80 thousand dollars is involved.

The need for this much engineering is recognized by men who know. Already much has been done toward getting the knowledge into handbook shape. Perhaps the best job of this sort to date is "Fundamentals Relating to the Design and Operation of Exhaust Systems" developed under American Standards Association procedure.

The Doctor's Part in Controlling Dust Hazards

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Considerable confusion has existed in the past as to just what is the physician's function in the prevention of dust diseases, and what is the engineer's. It is very obvious upon even casual thought that the two sciences must work hand in hand in their efforts to solve the problem.

The physician through his special training must be able to tell the engineer what dusts are dangerous and what are not. He must know how those dusts enter the body and the manner in which they do their harm. He must be trained in the examination of persons who are to be employed to work in dust, and to discover those who are already diseased, or are peculiarly susceptible to dust disease. He must be able to detect the first signs of disease in workers who are exposed to dust, and must be prepared to recognize the disease when it is fully developed.

It is not necessarily the physician's function to analyze dust. That is a task for the chemist and the petrographer. It is not the physician's function to count the particles of dust in a given industrial atmosphere. That, in reality, is the function of the engineer. It is not the physician's function to devise ventilating equipment for the removal of dust, nor even to be more than an adviser as to the means that must be adopted to render the atmosphere safe.

The physician nevertheless must correlate with his medical knowledge and with his studies of the industrial worker the findings of the engineer. A diagnosis of silicosis, for example, requires not merely characteristic occupational history and characteristic physical findings, but the knowledge as well that the patient has been exposed to hazardous dusts in dangerous concentrations.

All dusts when inhaled in excessive quantities may be considered as harmful, but only a few can be regarded as dangerous. From the standpoint of their dangerous properties, they may be divided into three general groups.

1. Those which are dangerous because of their poisonous action, such as lead, arsenic, mercury, and similar substances.

2. Those which cause only irritation in the respiratory tract, resulting in such conditions as bronchitis or local inflammation; such substances as vegetable fibre, cork dust, flour, starch, and other relatively innocuous organic or inorganic materials.

3. Those which tend to produce fibrosis of the lungs, thereby predisposing to respiratory infections, especially tuberculosis, such dusts as asbestos, silica dioxide or magnesium silicate.

I shall confine my remarks chiefly to dusts occurring in the latter category.

It has been generally believed that the harmful effects of dusts inhaled into the lungs depended more upon their physical structure than upon their chemical. It was believed, for example, that silica dioxide, or quartz, was particularly harmful because of its crystalline structure, and the hardness and sharpness of its particles. This conception is now known to be faulty. The dusts which cause their damage by mechanical interference with function are the dusts which are relatively innocuous, whose symptoms are transitory, and which subside upon removal from exposure to the dust.

Chemical Effect Is Harmful

The disease of particular interest to us today, silicosis, owes its harmful effects very largely to a harmful chemical reaction occurring between silica dioxide and the body tissues. It so happens that silica dioxide is decidedly a tissue irritant to the body, regardless of the part of the body it invades, it causes local irritation, local destruction of tissue, and the replacement of that tissue by scars.

Thus, given a dust containing silica dioxide in sufficient concentration, in sizes small enough to permit its entrance to the ultimate air spaces in the lungs, we have a situation which offers danger to the worker.

We have no real knowledge as to true figures, but as a simple rule, we can adopt for practical purposes the thought that the human body can withstand successfully a concentration of dust containing 100 per cent silica dioxide in a particulate size less than 10 microns, in a concentration not in excess of 5,000,000 particles per cubic foot. If we decrease the percentage of silica dioxide present in the dust, we can correspondingly increase the concentration with comparative safety. We must, of course, take into account the portion of the worker's time spent in the dusty atmosphere.

To arrive at a rough conception of a safe atmosphere, we multiply the percentage of free silica in a given dust by the total number of particles per cubic foot. If the result is under 5,000,000 the condition may be considered relatively safe. If the result is over 5,000,000 the condition must be regarded as unsafe.

Bear in mind too that silicosis is essentially a disease of great chronicity. Except in a few exceptional instances it will require from seven to thirty years for a worker to develop advanced silicosis. It is evident too that coincident dusts may either retard the development of silicosis or hasten it. Recent research seems to indicate that the admixture of aluminum dust to a silicious dust will greatly inhibit the reaction of the latter; whereas a silicious dust combined with some alkaline coincident dusts may hasten the development of silicosis.

Much research is now under way in problems such as this. We have never learned how to cure silicosis, but we are learning rapidly how to prevent it. Our knowledge in this respect seems to be limited to the removal of dust from the breathing zone of the worker. Later discoveries may show us how to modify existing dusts with contaminant dusts that will render silica dioxide innocuous.

Owing to its very great chronicity, it is only the rare case who actually develops disabling silicosis during his industrial lifetime. It is realized, of course, that exceptional instances take place, but the coincident ravages of age usually keep pace with the effects of dust, so that much of the disability usually attributed to silicosis is often, in fact, actually attributable to other diseases or incapacities which advancing years bring in their wake. To me the great peril of silicosis, the peril not only to the industrial

worker himself, but his family, co-workers and the public generally, is the accompanying susceptibility to tuberculosis.

Complicated by Tuberculosis

Silicosis per se does not kill. Tuberculosis as a complicating factor of silicosis rarely recovers despite treatment, and the individual so afflicted is not only totally disabled himself, but a definite menace to all with whom he comes in contact, particularly the fellow worker who may have silicosis. So perhaps the most important places in which the services of the physician in a dusty trade are necessary are—first, along lines of discovering and barring from exposure to a silicious dust those persons who may already have arrested tuberculosis; and secondly, discovering those persons already exposed to dust, possibly already silicotic, in whom tuberculous infections may have developed.

It is well recognized that no individual should be exposed to dust containing silica dioxide until he has undergone a thorough physical examination, including carefully made and interpreted x-ray films of his chest. It is likewise obvious to anyone familiar with silicosis that no person who is exposed to silicious dust should be denied the privilege of frequent physical examinations and x-rays of the chest, not entirely to discover the existence of possible silicosis, but to discover a coincident tuberculosis if such exists.

A man so diseased should, in protection to himself and to all with whom he comes in contact, be removed from industry. Let me emphasize the uselessness of a physical examination, unless it be accompanied by properly taken x-ray films, except in cases of gross tuberculosis.

It is the function of the physician, therefore, to conduct in a thorough and an intelligent manner the pre-employment examination of all persons who are to be engaged in a dusty trade. The purpose of this examination should be threefold. First, to discover and bar from employment in dust, any person who is suffering from tuberculosis in an active, a quiescent or an arrested state.

A possible exception might be made in individuals suffering from a so called healed primary complex, or a healed childhood infection. It is well known that exposure to silica dioxide is very likely to excite into activity a turberculous lesion which may be quiescent or arrested, and once such a lesion is reactivated, the chances of recovery are remote.

The second problem which confronts the physician at the pre-employment physical examination is whether a given individual is, by reason of secondary physical defects, more susceptible to the development of silicosis than a normal. Is he suffering from diseases of the nose or upper respiratory tract, such as chronic sinusitis, disease of the lungs or air passages, or obstructions which produce mouth breathing?

We must remember that silica dioxide is not dangerous until it reaches the lungs, and that the normal individual retains in the nose and the upper air passages a large quantity of the dust inhaled from the atmosphere. In instances where this nasal retention is disturbed, exposure to silica dioxide dust may be dangerous to that individual, where it would not be to another.

It is believed that certain diseases of the heart and circulation, of the kidneys, possibly syphilis, chronic coincident diseases of the lungs, all may render a man more susceptible to silicosis than normal. The physician at his pre-employment examination must follow certain established criteria in this respect, and bar from exposure to dangerous dusts those persons who through existing disease may be more ready prey to silicosis or tuberculosis.

Re-Examination Needed

After the applicant for employment has successfully passed his physical examination and is engaged in a dusty trade, the duty of the physician is not yet ended. This workman must be periodically re-examined, first to discover the early appearances of pulmonary fibrosis, but what is even more important, to detect the early evidences of complicating tuberculous infection.

A man should not be dismissed from employment in a dusty trade merely because he has evidences of non-disabling silicosis. Workers in dusty trades, especially stone cutters, moulders, pottery workers, and similar craftsmen, are usually highly skilled, and it seems unfortunate from a social and economic point of view to deny them employment so long as they are physically able to carry on, especially since the actual disabling qualities of silicosis are in doubt.

They should be denied employment in a dusty trade if that condition is found at pre-employment examination, but they should not be barred from continuing an employment in which they are already engaged. Of course, in such instances you, as engineers, must realize that you have failed, because if you had kept the breathing zone of the worker free from dangerous dusts, silicosis would not be present on physical examination.

In this work of preventing dust diseases in industry, it should be evident that the closest and most intelligent cooperation between the physician and the engineer is necessary. The physician must, through his knowledge and research, tell the engineer what dusts, or, for that matter, what other substances used in industry are harmful. He must tell the engineer how such dusts or other materials enter the body, how they leave the body and what they do in their passages through or their residence in the body.

Must Make Analyses

The engineer must in turn tell the physician of the harmful dusts and other substances surrounding his workers. He must make chemical and petrographic analyses of the dusts, and other indicated analyses of the atmosphere in the workshop. He must make dust counts and check his counts at regular intervals, conferring with the physician in an effort to discover whether, in the light of their joint knowledge, working conditions are dangerous. He must develop and install carefully designed ventilating equipment. He must arrange for modification of chemical and other industrial processes, where such modification is possible, and must bend his efforts toward removing from the danger zone of the worker the offending substance, whatever it may be.

Too many engineers construe this function loosely. They pass on to the physician as his responsibility certain functions which essentially are theirs; such functions as dust analyses, dust counts, and similar technical duties. All too often it is considered adequate merely to install a fan.

Ventilating devices in dusty work rooms must be constructed only after careful engineering study has given a knowledge of the physical properties of the air and of substances polluting it. It is possible to calculate to a very fine point the volume of air that must be removed from a given spot to remove the dust originating at that place, and the engineer must approach his task from just as scientific an angle as the physician approaches his.

There is no room in industry for haphazard methods on the part of either the physician or the engineer.

ADJOURNMENT

Industrial Fumes, Gases and Vapors

THURSDAY MORNING SESSION

October 14, 1937

The meeting was called to order by Voyta Wrabetz, Chairman, Industrial Commission of Wisconsin, Madison, who presided and introduced the speakers.

Injurious Effects of Metal Fumes and How to Prevent Them

By ROY R. JONES, M.D.

Division of Labor Standards, U. S. Department of Labor, Washington, D. C.

The inhalation of metal fumes is a common cause of illness among certain occupational groups. Two very different systemic reactions may result from breathing air containing particulate metal or metal compounds: (a) metal fume fever, an acute, transitory, non-fatal disease causing slight or temporary disability; (b) systemic metal poisoning, mild, severe, or even fatal in its effect. The same occupational exposure may produce both reactions, metal fume fever developing following the worker's early exposure, chronic systemic poisoning developing later as a result of prolonged exposure.

We may consider metal fumes as solid particles generated by condensation from metal in a gaseous state. Condensation is usually accompanied by oxidation.

There are two chief physical characteristics of metal fumes which bear a direct relationship to the ease with which they may be absorbed: (a) The solid particles are much finer than atmospheric dust, probably averaging less than .5 micron in diameter; (b) they tend to flocculate and settle out of the air as dust. The finer the solid particles suspended in the air, the longer the time required for them to settle out. Many of the coarser dust particles in the air are trapped in the upper respiratory tract and by the ciliated cells lining the trachea and bronchi, while the finer particles may be carried to the terminal air spaces of the lungs. Here they are taken up by the phagocytic cells and are eliminated chiefly by way of the blood and lymph.

Sayers and his associates[1] found that only about 15 per cent of inhaled particulate matter, such as lead dust from automobile exhaust gas, was retained in the lungs, the remainder passing out with the exhaled air. Drinker and his associates[2] and Brown[3] made quantitative measurements of fumes retained in the lungs. They found a direct relationship between the percentage of fumes retained and the size of the particle and the density of the fumes breathed. They also showed that slow deep breathing increased the reaction resulting from inhaling zinc fumes. Such breathing should increase the percentage of particulate matter retained.

Hazardous Processes

For convenience we may place the more common occupational environments which are likely to afford a harmful exposure to metal fumes in three large groups:

1. Smelting of ores and refining of metals.
2. Employment at processes handling molten metal such as molding, cutting, and welding operations.
3. Salvage and cleaning operations, including the burning of metals or metal covered objects, especially by means of acetylene torch or electric arc.

In the first class, the ores or metals processed provide the source for the generation placed in the main exit. We had "Fourth of July" across the top. "Automobile accidents" with a question mark; "Persons injured" with a question mark; "Persons killed" with a question mark; and then in brackets on the outer edge, "Do your part to keep these at zero." Then just a little phrase at the bottom here: "Remember this, safety is like a ball game. It is the number of times you arrive safely at home that counts."

ADJOURNMENT

Pressure Vessels

WEDNESDAY MORNING SESSION

October 13, 1937

The session was called to order by Chairman Dan L. Royer, Chief Engineer, Ocean Accident and Guarantee Corp., New York City, and General Chairman, ASSE Engineering Section, National Safety Council. Mr. Royer introduced the speakers.

The address prepared by Mr. Gibbs was read by Ralph M. Moon, of the same firm.

What the Safety Man Should Know About Steam Boilers and Steam Lines

By E. R. FISH

Chief Engineer, Boiler Division, The Hartford Steam Boiler Inspection and Insurance Co.

With respect to steam boilers and steam lines, the safety man should be familiar with those factors that produce weaknesses resulting in failures—factors that are prejudicial to the safety of personnel and property. The safety man is not necessarily concerned with efficiency of operation, but he is concerned with how the equipment should be operated in the interest of safety.

The term steam boilers and steam piping covers a great variety of equipment ranging from the inconspicuous steel or cast iron heating boiler, the pressure of which rarely exceeds 10 or 15 lbs. per square inch, up to the mammoth steam generating units capable of evaporating over a million pounds of water per hour at a pressure of 1,400 lbs. per square inch and delivering steam at a temperature of 900 to 950 degrees F.

Obviously, such a wide range makes it impossible to discuss the various factors that affect each of them. However, there are certain fundamentals applicable to boilers of both high and low degree.

Internal Deposits

Deposits or accumulations on the internal surfaces of parts of boilers exposed to high temperature gases interfere with the rapid absorption of heat. When directly in contact with the metal, water absorbs heat at a sufficiently rapid rate to prevent the metal from becoming overheated. However, interfere with this orderly process and the metal very rapidly overheats to the point where it loses practically all its strength. Internal pressure then pushes the metal out and causes the so-called "bulge."

In water tube boilers bulges on tubes not infrequently break through, and while they do not often cause any serious consequences to the attendants, sometimes steam or flame are driven out through openings in the settings and some one is injured. In horizontal return tubular boilers the result is likely to be much more serious both from a personal injury and expense point of view.

Bulges in boilers of this type very frequently break through and, being directly over the fire, flame and live coals are very likely to be driven out of the furnace. Many state laws now require fire doors to be equipped with automatic latches that prevent them from being blown open when they are closed. Bulges in H.R.T. boilers have frequently opened to such an extent that a true boiler explosion has happened and great property loss as well as personal injuries and death have resulted.

A serious explosion of this kind happened

Steam gages sometimes give wrong readings and need to be tested frequently. Blowoff connections, particularly on horizontal return tubular boilers must be of sturdy construction and properly protected from high temperature gases. Blowoff valves must also be of heavy construction and so arranged that they cannot be quickly opened or closed. There have been a multitude of accidents to persons due to failure of some part of the blowoff connection resulting from improper materials, improper operation and insufficient protection.

Attendance

The proper and safe operation of as important and potentially dangerous a piece of apparatus as a steam boiler, be it either high or low pressure, large or small, is dependent on intelligent attendants and should be entrusted only to the care of those who are thoroughly competent. This is a point that is by no means universally complied with, even, oftentimes, in power plants of moderate size.

The value of the equipment in a very large plant is such that the management cannot do otherwise than provide it with the best possible care and attention. However, there are many boiler plants that are but very inadequately attended and in thousands of small heating plants the attendant is wholly uninformed and ignorant.

Piping

Steam piping is not a source of very many accidents. The failures that do take place are usually in connection with cast iron fittings, such as tees, elbows and the valves, and usually in the pressure line.

Water hammer not infrequently occurs in steam lines, especially when starting up cold. A slug of water traveling at a high rate of speed can deliver a sledge hammer blow at an abrupt change in direction or dead end, and many cast iron fittings are broken in this way. Expansion and contraction stresses that are not properly provided for, not infrequently result in cracked fittings or valves that permit the discharge of steam. Even low pressure steam is at a temperature such that serious injury results from coming in contact with it.

Most piping is covered with insulation so that it is not easily examined, but the bolts and flanges and the provision for proper expansion can be checked.

Construction and Repairs

Safety men probably do not often have any part in the selection of equipment or methods of construction or repair, but it is well for them to know that a great deal of welded boiler work is now being done and many pipe lines are being fabricated by welding instead of the usual threaded and flanged construction. Every possible assurance must be taken to determine that the welding process will give sound welds with the proper physical characteristics. Also that only welding operators are permitted to do the work who have demonstrated their ability to produce sound welds under the prescribed procedure.

There have been so many instances of improperly welded joints, both in pressure vessels and piping, that every precaution should be taken to assure welds of an acceptable and safe nature. There need be no great concern about welded boilers, because that work is invariably done in shops that are properly equipped and supervised. This, however, is not necessarily true with pressure vessels of various kinds.

There is a great temptation to effect repairs of boilers and other pressure vessels by welding. Repairs of this kind should be permitted only after thorough analysis of the conditions and then only by proved, competent welding operators. Rules have been adopted by the National Board of Boiler and Pressure Vessel Inspectors respecting the application of welding to boiler repairs that are highly restrictive.

The American Welding Society has prepared rules for the Qualification of Welding Processes and Testing of Welding Operators.

Both the rules for repairs and the qualification of welders should be familiar to those concerned with equipment to which welding may be applicable.

Less than six months ago the welded-in patch in the bottom of a horizontal return tubular boiler in a saw mill failed. The patch measured 24" x 36" and was sufficiently large to cause a major explosion. One man was killed and the boiler house was demolished. An examination showed that it was a miserable job of welding, evidently done by one entirely ignorant of the danger of that kind of repair as well as being an inexpert welder.

Personal Injuries

Many personal injuries caused by exposure to steam or high temperature water, the discharge of which may be due to a relatively minor accident, are constantly happening. Many of these occur because of carelessness or ignorance on the part of the injured person but many of them are through no fault of the injured man.

Meticulous attention to small details is necessary to avoid the minor accidents. Innumerable injuries have been due to men working on, or attempting to make repairs of, parts under pressure. It should be an invariable rule that the tightening up of bolts in an attempt to stop gasket leaks or making other repairs involving hammering or possibly welding should be positively prohibited while the equipment is under pressure.

Furnace Explosions

Furnace explosions are of rather frequent occurrence, particularly where gas, oil or pulverized coal is used as the fuel. Great care and an orderly method of both lighting off and operating furnaces using these fuels is very necessary.

The lighting means should be introduced only after a furnace has been well ventilated and before the supply of fuel is started. Some very disastrous explosions have happened in large boilers fired with pulverized coal, gas and to some extent with oil. Small automatically oil fired heating boilers very frequently have furnace explosions, but they are not usually of a serious nature. This kind of accident is worthy of careful consideration by those concerned with boiler operation.

Only a very few years ago a furnace explosion of natural gas occurred under a new 600 pound boiler in a city electric light plant in Colorado. One man was killed and four injured. The property loss was approximately $25,000. The boiler was just being prepared for service by men who were familiar with the use of natural gas fuel. Apparently the mismanipulation of valves and failure to take the necessary preliminary precautions by ventilating the furnace before lighting off was the cause.

What the Safety Man Should Know About Compressed Air Systems

By CHARLES W. GIBBS

Compressor Engineer Department, Ingersoll-Rand Co., New York City

Power, to most people, including engineers, means electricity or steam. To a few it means water power. Less frequently is compressed air thought of as power. It is more likely to be considered a convenience. Compressed air is probably actually handled by more workmen in the average plant than either steam or electricity. Compressed air is a personal utility, but it is also power.

Because of this familiarity with compressed air and because of its generation and use in so many small shops (practically every gasoline station has its compressed air plant), the question of safe *installation* and operation is important. This paper will not attempt to cover the actual use of compressed air, but will be limited to the installation and maintenance of the stationary compressor plant and system.

All of the equipment should be designed for the maximum pressures which *might* be encountered. All reputable manufacturers of compressed air equipment can offer units for practically any service which will provide an ample factor of safety.

For the type of plant which the safety man will generally be called upon to consider, the operating pressure will seldom be above 150 pounds, and the compressors will be either single or two stage. By this we mean that the air will be compressed to discharge pressure in one stroke of a piston (single stage), or it may be compressed part way in one cylinder and then transferred to another cylinder and compressed the rest of the way (two stage). In general, machines above 100 horsepower will be two stage, the power requirements for 100 pound units being about

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WEDNESDAY LUNCHEON SESSION

October 13, 1937

The annual meeting of the ASSE-Engineering Section of the National Safety Council followed a luncheon and convened with D. L. Royer, Ocean Accident and Guarantee Corporation, New York City, general chairman, presiding. All reports had been mimeographed, and copies were distributed at the luncheon.

A report of the address delivered at the meeting by Elmer A. Holbrook, dean of the Schools of Engineering and Mines, University of Pittsburgh, Pittsburgh, Pa., will be found elsewhere in this record.

The report of the nominating committee was presented by C. W. Smith, chairman. Other members of the committee were A. S. Regula, S. E. Whiting, Dr. M. G. Lloyd, and R. F. Thalner. The committee's list of officers, as elected, will be found in this section of the Congress Transactions.

Other sessions sponsored by the ASSE-Engineering Section included those on "Safe Use of Acids," "Industrial Dusts," "Pressure Vessels," "Industrial Fumes, Gases and Vapors," "Safety Training," and "Safety Inspectors."

Engineering and Industrial Accident Prevention

By E. A. HOLBROOK

Dean, Schools of Engineering & Mines, University of Pittsburgh, Pittsburgh, Pa.

The essence of early safety work was the safety education of the worker. Education has ever been one of the two legs supporting safety.

We did not go far in our safety program until we discovered that safe materials, safeguards, safety standards and safe equipment were equally potent with worker education in reducing accidents. These material things constitute the second leg of our safety body.

I notice with pleasure a wide diversity of use of the term "engineering" in the world of safety. There is nothing to tell you that a man must go to college to be a safety engineer. Nevertheless, an engineering college is perhaps the place where a man may learn easiest how to design a safe boiler or building or of the thousand and one material factors of safety that we associate with engineering. He learns there also how to draw conclusions from his facts, and we trust he may later in practice *act* with professional wisdom.

When we remember the efforts of the Red Cross thirty years ago, or we read again the first mine inspection act in Pennsylvania, there was little to indicate that safety ever would be of professional engineering interest. Today when you consider the enormous accumulated data on the material side of safety, engineering of its writings, its myriad standards, its exacting practice, you must admit that to absorb, interpret and apply this world of material requires a mind trained to the college or equivalent level. As a parallel example, electrical engineering was unheard of before 1880, yet in the past 50-odd years, it has through research and practice, accumulated data, writings and standards of such importance and variety that the single human mind cannot in a lifetime span the whole field.

Think again of those modest beginnings of safety, mostly in the minds of men in the mining, metallurgical and railroad industries. Slowly it felt its way, largely with a humanitarian background. Then came workman's compensation, giving the work a definite economic background. Finally, and with increasing acceleration, the methods and practices of safety have penetrated today not only into every corner of our industrial world, but into our individual daily life. Certainly as regards industry, I am ready to admit that Safety Engineering has arrived; that in its historical development, in its penetration of organization and management, in its influence on production, economics and design, and by its high standards of research and practice, Safety Engineering is on a plane where it demands a place in our engineering college curriculum.

The curious fact remains that in general the engineering colleges of this country have not yet assigned to safety engineering any definite recognition.

Several years ago it seemed that the time had come where in a great industrial center like Pittsburgh we should offer a course in Safety Engineering on a college level. We determined in this course not to deal with safety as applied to any specific industry, for we believe that *in* these industries themselves, the special application of safety principles best can be mastered. Rather we tried to uncover the basic principles or essence of safety engineering, common to and of interest in all industries. Thus our year's outline for the subject covered purposes, origin, growth, agencies, and organization for safety work; industrial hazards, management responsibility, and safety education. Then came individual accidents, their causes, costs and prevention; accident classification, machinery and the human factor, design as affecting safety; safeguarding the working place, inspection, and materials handling. Finally, we studied safety codes and standards, workman's compensation (origin and rate making), and methods and results of safety work in typical industries.

This class has gone on for some seven years; first under its founder, the late Dr. J. W. Hallock, and for the past two years under Irvin Brinkman, safety director of the McIntosh-Hemphill Company. The classes have varied between 20 and 70 men enrolled. A curious difficulty has been the absence of a satisfactory text book. Is it not noteworthy that although there are hundreds of college text books covering almost every conceivable engineering subject, I know today of no text suitable for a college course in safety engineering. The Armour Institute of Technology has admirable courses in fire prevention engineering, and Harvard University has undertaken extensive work in traffic and highway engineering and recently has offered 15 fellowships to men wishing training in this field. These exceptions bring out by contrast how little attention most engineering colleges give to safety.

Perhaps it will take another generation of engineering teachers to recognize that today safety is a part of every engineering problem and as essential as the items of cost, good design, probable life, and general usefulness.

You of the National Safety Council have done a great work in educating employees and employers, insurance companies, standardization agencies, the child in the school, the man on the street, and the woman in the home. But for some reason you have not made the engineering colleges safety conscious.

You have accumulated writings and data so vast that no single mind can absorb them.

You know that your continued success depends upon diffusing safety knowledge this year and next, yes even from generation to generation. You should have at work men trying to explore for that essence in safety problems which I sometimes think cannot wholly be expressed—it can only be felt.

May I call attention here to the fact that, so far as we know, a college or a university is likely, next to the church, to be the most enduring agency of civilization. Even in this young country, Harvard University has celebrated its three hundredth anniversary, reminding us that it has outlived changes in government, in religion, and in peoples. Essentially it has been the repository of great ideals and truths, equipped to pass the torch down from generation to generation, undimmed and often refueled. For this reason alone, I say to the National Safety Council that you ought to form an alliance with one or more American engineering schools, trusting in this way to insure the perpetuation, without fear or favor of all that is at the heart of safety.

I believe also that within a college, and away from the stress of economic struggle, where research in safety principles can best be carried on, you would find, through support of a chair of safety engineering, that out of it would come a sifting of wheat from chaff, an extraction of the essence from the mass of material things.

Of a more practical nature, an engineering college department interested in safety should be able to put out text books on safety, more valuable therefore to the student than the general references we now have to use.

On this foundation must come courses in the principles of safety engineering offered to the undergraduate engineering student. Whether you like it or not, the truth is that the bright young boys of today go to college, most often to an engineering school, whereas the similar boy of 30 years ago generally entered industry after high school. This means that the future safety engineers and industrial leaders are largely going to be products of a four year college engineering course.

Safety engineering can't just be discussed like politics. It must be felt, it must be lived, it must be instilled into these young engineers firmly. Then and then only will they react instinctively to safety in engineering. I do invite, most earnestly, the attention of the Executive Committee of this Council to the need, through cooperation with the engineering colleges, of educating our future engineers in safety.

ADJOURNMENT

Automotive and Machine Shop — Power Press Sections

Automotive and Machine Shop

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C. T. Winegar, Chrysler Corp., Detroit, Mich.

TUESDAY AFTERNOON SESSION

October 12, 1937

Sessions of the Automotive and Machine Shop and Power Press Sections were held jointly. A list of officers of the Power Press Section will be found on page 535 of this volume.

The opening session was called to order by Acting Chairman M. J. McCarthy, Safety Director, Fisher Body Div., General Motors Corp., Detroit, Mich., who introduced the speakers.

Developing Safe Workers Through the Employment Office And Job Training

By HARRY C. BIGLER

Personnel Director, Research Laboratories Division, General Motors Corporation, Detroit

The employment man is in the best possible position to instill safety consciousness in the minds of new employees. He is the first representative of the company to contact the new employee. His responsibility for safety is as great as that of the safety engineer or foreman, due largely to his opportunity to observe the physical and mental qualifications of the applicant. He meets the new man when he is in the mo[st] receptive frame of mind.

While he may not be able to judge [a] man's ability to perform a certain operati[on] efficiently and it may not fall within [his] line of duty to teach the rudiments of [the] job, he should explain company policies a[nd] place special emphasis on safety. Th[ere] should be no hesitancy in explaining th[at]

the company will not tolerate accident-prone employees, for they are distinct hazards to themselves, their fellow workers, and to company property. The employment man should be thoroughly familiar with conditions surrounding the job for which he is selecting a man. He should know the fatigue elements and the types of workers required for the job, remembering that upon his ability to select men depends the functioning of a smoothly running organization. The employment office itself can be an important factor in creating the correct impression on the new employee—neatness and orderliness of the office and surroundings can indicate the type of good housekeeping in the plant, so essential to proper safety conditions.

The prospective employee is undoubtedly anxious to obtain the job and make good. Since he has his mind set on conforming to the requirements of a new job, new associates and new environment, he will undoubtedly react to new ideas on safety, especially when the benefits he will derive are explained.

No man will deliberately cause injury to himself or another, nor do I like to charge an injury to carelessness on the part of the person injured. Carelessness might be the under-lying cause of an injury—but whose carelessness? Did the employment man do his duty, or simply provide a book of safety rules containing a hundred or more don'ts?

I recall an incident where a new man was [b]eing "written up" in one of our plants. He [w]as handed a book of rules on safety and [t]old to read them carefully. After going [o]ver them slowly he laid the book down [a]nd indicated that he understood their [m]eaning. When asked to sign his name to [t]he employment card he made an X. What [g]ood were written rules in this case? The [m]an could neither write nor read, and yet [h]e could not be denied the right to work.

Experience has taught us that a little [ex]tra time spent by the employment man [an]d departmental foreman with a new em[pl]oyee before he actually starts work will [no]t only pay dividends in the form of [qu]ality and quantity of workmanship, but [wi]ll greatly reduce human suffering and [ac]cident costs. In early years, an attempt on [th]e part of anyone to encourage selective [em]ployment was often frowned upon by the [em]ployment man who considered it an encroachment upon his authority. However, the introduction of compensation laws and labor legislation in many states, the tremendous labor turn-over costs in industry, and the increases in insurance premiums helped to bring to the attention of managements the idea that some medium of control had to be exercised. Consequently, the safety engineer, thought of in terms of a necessary evil or disease, slowly found his way into the spotlight and his job from then on was definitely outlined.

The plant physician can also take a place among those responsible for the development of safe workers in industry. The final selection of any man is subject to the approval of the medical staff. While the employment man concentrates on the mental and experience qualifications of the new man, the physician decides on the physical fitness angle. The plant physician, in other words, acts as a double check on the proper selection of a new employee.

The railroads were among the forerunners of the safety movement and soon realized the value of educating the workers on accident prevention and accepted as an integral part of their program the selective training of engineers, firemen, brakemen, and round house employees. Their program designated special training periods for each employee and the employee was advanced accordingly.

The metal working industry finally took a leaf from the railroad manual and used it as a pattern to organize and develop safe workers. It was a good experiment indeed, for a review of the industry's accident experience shows the success in the reduction of industrial tragedies that plagued the industry in the early years. Taking General Motors' record, our frequency rate in 1937 is only one-sixth of that in 1925 and the severity rate only one-third. I'm sure other units of the automotive industry can show a similar improvement.

At one of our plants a very effective plan was recently adopted and has been successful in developing safety consciousness among new as well as older employees. This plant held regularly scheduled "executive training" meetings for the purpose of developing the best possible kind of leadership. Company policies and their effect upon good workmanship and production schedules were discussed. Accident prevention methods were suggested or at least discussed in an

Cement and Quarry Sections

Cement Section

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GORDON C. HUTH, Universal Atlas Cement Co., Chicago, Ill.
E. POSSELT, Lone Star Cement Corporation, New York, N. Y.
J. B. ZOOK, Great Lakes Portland Cement Corp., Buffalo, N. Y.

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Members at Large—

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F. E. TOWN, Medusa Portland Cement Co., Manitowoc, Wis.
J. B. ZOOK, Great Lakes Portland Cement Corp., Buffalo, N. Y.

SI. I believe that our general safety meetings will mean more to the men if, instead of having outside speakers all of the time, we should make the programs more our own organization; using our own men as speakers and possibly working up considerable discussion in taking cases from the Round Table that is put out by the Association; also devoting a part of the time in the study of our safety regulations.

S. That is an idea, and I would suggest that you work up next month's program along that line. Has anybody else got an idea?

SF. I have one. I suggest that we have a rule requiring any faulty ladder or other tool to be taken to the storeroom; and let it be the safety inspector's responsibility to see that such a tool does not go back in the tool room until properly checked and repaired by some craftsman.

S. That's a good one, and we will give it immediate consideration. In addition, I suggest that we pick out a man from each department and bring him in to our safety committee meetings, rotating these men so that we can eventually have them all meet with us, thus giving these men a closer insight as to our safety work and permit us to get their ideas. Also, I will, until further notice, hold weekly meetings with all the foremen wherein we can make clear the additional duties that you men must assume, one of which will be to see that your men are acquainted with our safety rules and the training of new employees. We can also discuss various individuals who do not seem to be cooperating one hundred per cent.

Is Training a Vital Factor in Effective Safety Work?*

By F. M. PEPPER

General Plant Employment Supervisor, Illinois Bell Telephone Co., Chicago

Much of the effort spent in safety work has been more or less inspirational in character, with considerable stress placed on selling the idea of safety.

Too much time and effort have been spent in stimulating our people to do something to prevent accidents and in inspiring them, and too little time and effort in teaching them how. The job is essentially one of adequate training, both for the supervisor and man. The essential considerations in those management functions which are concerned with doing the job safely are no different from those management functions which are concerned with securing a product for which the industry is organized.

Effective supervisory training means securing effective supervision for the job as a whole. When a job is well done, preventable accidents will be at a minimum.

There should be a tendency to set up procedures which are apart from the usual supervisory functions. Prevention of injuries on the job is a matter which lies almost entirely in the hands of the direct supervision of the job.

One of the most difficult problems facing us today is to return to the foreman his responsibility for the safe doing of the job which, by various measures, we have taken away from him. He must feel that the safe doing of the job is his responsibility and feel that he is the man to do something about it.

Rarely, if ever, is there an accident on a job which is considered particularly hazardous.

We must not assume that the foreman or supervisor knows how to conduct the work safely. We must be sure that he does and assist him through a proper training program.

It is safe to assume that a majority of all fatal and serious accidents are directly or indirectly attributable to the failure of supervision at some level to function properly. It is quite evident that supervisory training as a means of avoiding accidents is necessary.

The development of a supervisory training course is a much more difficult procedure than the development of a technical or vocational training course. Apart from the technical features involved, there does not seem to be any general formula. There is, of course, some similarity of procedure in directing the work of any man on any job; but different industries employ such different types of people, under such a wide variety of circumstances, and place such a divergence of requirements upon them that the problem of supervisory training in its more comprehensive aspects is peculiar to each type of industry.

The general treatises on leadership give the groundwork, but the subject matter for any supervisory training course for any particular industry lies within that industry. We must go out and see how our job is being supervised now; analyze the procedure of every foreman and supervisor; compare them and select the best; look upon supervision as a process in itself, and see how best to direct the work of the people. It is a long, tedious, and costly process, but one which, carried through to completion, will pay dividends in the end.

*Editor's Note: This is a brief abstract of Mr. Pepper's address.

WEDNESDAY LUNCHEON SESSION

October 13, 1937

The Wednesday Luncheon session of the Cement and Quarry Sections was addressed by Isaiah Hale, Superintendent of Safety, Atchison, Topeka and Santa Fe Railroad, who spoke on "The Common Sense of Safety." The address was substantially the same as another address by Mr. Hale before the Steam Railroad Meeting. The complete paper will be found in the Steam Railroad section of this volume.

WEDNESDAY AFTERNOON SESSION

October 13, 1937

Work of the National Silicosis Conference

By R. CAMPBELL STARR

Assistant Safety Engineer, U. S. Department of Labor, Division of Labor Standards, Washington, D. C.

Silicosis is strictly an occupational disease. Medical science has not reported silica dust as affecting any individuals except those who, over relatively long periods of time, have worked in an atmosphere where the air which they breathe contained excessive concentrations of free silica.

The interest of the U. S. Department of Labor in a broad social and economic problem such as this has its origin in the Organic Act, effective March 4, 1913, which created the Department. This act, among other things, gives the Department of Labor the duty "to foster, promote, and develop the welfare of the wage earners of the United States, to improve their working conditions, and to advance their opportunities for profitable employment."

With this in mind, and believing that through joint effort of all concerned, much could be done to eliminate the hazard, the Secretary of Labor called together in Washington on February 26, 1936 a group of about 75 men representing leaders in industries having a silica problem, labor leaders, and outstanding representatives of the medical, legal, and engineering professions, as well as insurance carriers and State administrators.

After considering various phases of the silicosis problem, this group generally agreed that through a pooling of knowledge and a frank discussion through the conference method important advances could be made toward, first, overcoming the hysterical attitude on the part of employers, labor, and others; second, after careful investigation, to consolidate in one place all known data with regard to the preventive engineering methods; third, analysis and recommendations in connection with adequate standards of compensation for those workers disabled as a result of the disease.

As an outgrowth of this initial meeting, another group, similar in composition to the first conference, but expanded to include some 200 individuals, was invited to come to Washington on April 14, 1936 to outline ways and means of attacking the problem. After hearing silicosis discussed from the standpoint of the employer, labor, and the medical profession, by outstanding experts in the field, this large group endorsed the conference method as proposed, and as a result four main working committees were appointed by the Secretary of Labor with the advice and consent of the group to investigate and report upon the outstanding phases of the silicosis problem. These committees were:

(1) Committee on the Prevention of Silicosis through Medical Control,
(2) Committee on the Prevention of Silicosis through Engineering Control,
(3) Committee on the Economic, Legal and Insurance Phases of the Silicosis Problem,
(4) Committee on the Regulatory and Administrative Phases of the Silicosis Problem.

A fifth committee, known as the Correlating Committee, was named. It was under the chairmanship of W. H. Cameron, Managing Director of the National Safety Council, and consisted of the chairman of the four technical committees just mentioned and two advisors, one on labor problems and one on mining matters.

These committee members served without compensation and gave freely of their time and effort in studying the problem from their respective viewpoints. After nine months of careful and searching study, these committees advised the Secretary of Labor that they were ready to report. Consequently, on February 3, 1937 the Second National Silicosis Conference was called in Washington. At this time summary committee reports were presented to the Secretary and considerable discussion was given them.

Shortly after this second national conference the Department published, as Bulletin No. 13 of the Division of Labor Standards, the summary reports of the four committees referred to above, together with an abstract version containing the principal findings and recommendations written in non-technical language.

The full reports of the committees, comprising several thousand typewritten pages, are now being edited and will go to the printer very shortly. It is expected that they will be issued in four separate volumes sometime during the fall or early winter.

Nature and Extent of Silicosis

Physicians generally agree that silicosis, in the layman's language, is a disease of the lungs, caused by breathing air containing silica dust, in which the normal lung tissue is replaced by fibrous or scar tissue.

Silica dust is found in many industrial operations, but the hazard is acute only in such industries as metal mining; anthracite mining; quarrying, drilling, and tunneling in granite, ganister, and sandstone; smelting and refining; foundries; potteries; glass works; stone-products industries; grinding; buffing; and sandblasting.

Of the 49,000,000 workers in the United States, only 1,000,000, or 2 per cent, it is estimated, are in any way exposed to the hazard of silicosis. About half of this number, or 1 per cent of the total number of workers in the country, are exposed to a serious hazard, and approximately 110,000 of these have silicosis in some degree. Medical examination of men actually at work indicates that between 4,000 and 5,000 workers are seriously affected by the disease, in addition to those already permanently detached from their employment by reason of disabling silicosis.

The status of the 1,000,000 workers exposed to the hazard of silicosis was analyzed thus by the committees making the survey:

A percentage of the 4,000 to 5,000 workers having silicosis are completely or partially disabled because of this disease and have their difficulties further complicated with tuberculosis.

The remainder of the 4,000 to 5,000 have silicosis and disability in some degree, but no tuberculosis.

Approximately 105,000 have silicosis, but no disability and no tuberculosis.

Approximately 900,000 are exposed to silica dust, but have not contracted the disease.

Contrary to popular belief, silicosis is slow to develop. Usually it takes seven years or more of exposure to silica dust for a worker to contract the disease. A few cases that have been known to develop in as short a period as one and one-half years occurred under extreme and unusual conditions. On the other hand, many workers have labored under ordinary exposures to silica for more than 30 years without demonstrating any trouble whatever that could be diagnosed as silicosis.

Silicosis Prevention

Silicosis can be prevented in three general ways: First, by preventing the creation of silica dust; second, by preventing the dispersion of dust into the atmosphere of a working area; and third, if it is impossible to apply the first two methods, by the use of personal protective equipment such as respirators, to prevent the inhalation of the dust.

In carrying out a prevention program, many agencies must cooperate. In the view of the committees studying the problem, the employer is called on to do most of the work and to spend most of the money. But his work and money will never accomplish the maximum results unless the worker is willing to cooperate and carry his share of the responsibility for helping to control dust and for using the personal protective equipment.

In addition, physicians can play a definite part in preventing silicosis, as can also engineers, insurance companies, legislators, administrators, and others.

The reports of the conference committees on engineering control and medical control recommend specific procedures for attacking the problem through those two avenues of prevention. A partial list of these recommendations follows:

Survey the working conditions to determine the severity of the hazard and indicate what needs to be done to decrease it.

Secure information on best procedure.
Design plant for dust control.
Provide building ventilation.
Store dusty materials in dusttight bins.
Enclose material-handling equipment.
Isolate dusty processes.
Provide wet methods of operation.—

Water, oil, and other liquids may be used effectively—

1. To suppress dust at the point of origin in such operations as rock-drilling; handling, pulverizing, and milling rock and ore; grinding metal on grindstones; abrasive-wheel cutting of granite and sandstone.

2. To prevent the redispersion of dust that has settled on the floors, walls, and other surfaces such as in the granite industry and in foundries.

Design equipment to control dust.
Establish good maintenance and housekeeping procedure.
Provide respirators.
Instruct the workers.

Responsibility of Workers

The cooperation of the workers is necessary if the hazard of silicosis is to be reduced to the minimum. The worker should realize that the safe practices recommended and the equipment provided are designed to prevent injury to himself and to his fellow employees. The equipment should be used as directed and every effort should be made to maintain it in good working order. Furthermore, the worker is frequently in a position to observe faulty equipment and unsafe practices, and he should make it a point to report all such conditions to his supervisor.

Statutory Regulation

While the primary approach to the problem must be the prevention and diminution of the hazard, the fact must be recognized that until silicosis has been wiped out, workers who now have the disease, as well as those who may contract it, must receive workmen's compensation just as do those workers who are injured in accidents.

Accordingly, the committees of the silicosis conference were unanimous in presenting the following recommendations:

Coverage for silicosis in the compensation acts of all States.

This coverage should be compulsory.

Because of competition between the same or similar industries in various States, the laws, rules, and regulations of the several States should be as uniform as practicable.

Should Be Insured

The employer should insure his obligation for compensation either through self-insurance subject to the posting of adequate funds, or with an authorized insurance institution.

Insurance should not be denied any employer, provided the State authorities certify that he complies with the State requirements as to proper safe working conditions, and pays the premiums involved.

Workers having active pulmonary tuberculosis and silicosis should be removed from employment. Such workers should be granted suitable compensation payments and medical care.

Workers disabled from silicosis (but with no tuberculosis) should ultimately be granted the same amount of compensation as those disabled by accidental injury.

Two years is a reasonable minimum limitation period for filing claims subsequent to the date of the last exposure.

Further Activities of the Department of Labor

In carrying out its duty as stated in the basic law, the U. S. Department of Labor has conceived that there is immediate need for the conversion of known facts in the medical and engineering fields working toward prevention, and in the legal, insurance and regulatory phases looking toward adequate workmen's compensation, into a practical, readily understood program which will adequately take care of the silicosis problem.

In its program of cooperation with the 48 States, the Department of Labor has included a section covering silicosis and similar dust diseases. This breaks down into three main sub-headings: (1) Assistance in the preparation of reasonable and adequate codes, rules, and regulations prescribing methods of prevention; (2) assistance in the establishment of equitable standards of workmen's compensation for those employees disabled as a result of the disease; (3) a general educational program among State officials, factory inspectors, etc. so that they will be equipped with adequate knowledge concerning the disease, its method of prevention, and its proper treatment under the workmen's compensation law.

Follows Two Lines

This application program, which is just now getting under way has been commenced along two principal lines: (1) The compiling of practical information concerning actual dust control installations in typical silica hazardous plants, together with approximations as to cost, not only of installation, but also of maintenance of dust control equipment in such plants; (2) a program of visual education supplementing the summary and full committee reports of the National Silicosis Conference. It is contemplated that in this field such media as film strips, lantern slides, posters, illustrated bulletins, etc. will be utilized. Further, in connection with the various exhibits of the department, shown at various large expositions, trade associations meetings, labor and technical organization meetings, etc., it is contemplated that much factual information will be used, pointing toward ways and means of correcting the hazard and of establishing adequate standards of workmen's compensation.

Following the address by Mr. Starr a round table discussion of outstanding hazards in quarry operation took place. This concluded the Wednesday program.

THURSDAY AFTERNOON SESSION

October 14, 1937

Methods Used by a Sand and Gravel Company to Win the National Safety Award

By H. A. KOOP

Safety Director, Lyman-Richey Sand & Gravel Corporation, Omaha, Neb.

The Lyman-Richey Sand & Gravel Corporation operates 22 plants, located throughout the state. Each plant is operated as an individual unit, normally employing one foreman and from three to six men on each shift. Total annual employees number 200 to 250, with an average of 275,000 to 325,000 man hours.

All production operations are by lake type dredges, involving such hazards as usually result in electrocution, falling, burning, and drowning.

Although our safety problems were the same as those of most small operators, our record in the year prior to the safety program was 79 lost-time accidents in 163,275 man hours' exposure. In fact, there were so many accidents reported that we received very unfavorable comment from the State Compensation Commission, and some insurance firms flatly refused to insure us.

It was evident that the system of each plant looking out for its own safety was all "haywire," so a safety program for all plants was decided upon and put into operation in the following manner.

First, an old employee, well versed in all plant operations was selected as safety director, devoting his full time to safety work.

Second, all employees were required to pass a physical examination. Most of the employees passed this examination, but a number were found to be physically unfit.

Third, all machinery and equipment were made as mechanically safe as possible; guards placed on gears and around open moving parts, ladders carefully inspected and guards built over them, hand rails and toe boards placed around platforms and on stairways, electric equipment checked for improper size switches and faulty wiring.

Fourth: An annual meeting of all foremen was decided upon to discuss safety plans, and plant operations. This proved very profitable, since from experience we had observed that the attitude of the foreman is reflected in the workman.

Fifth: In addition to the trophy to be won in a safety contest, substantial cash awards were given the foremen having the best plant safety record; and we honestly believe these cold, round dollars did more than anything else in keeping up interest in safety and plant competition.

Sixth: All plants were provided with bulletin boards, posters and first aid kits.

Seventh: The policy was adopted of holding each foreman directly responsible for his plant and each operator responsible for the condition of that particular part of the equipment he was operating.

It was the duty of the safety director to go from plant to plant, making routine inspections, observing, and instructing when necessary in methods of safe operation, and conducting plant safety meetings.

At these meetings all plant safety problems were discussed, and the men encouraged to make any suggestions in regard to equipment or its operation that would tend to eliminate future accidents. Many good ideas, successfully executed, originated from this source.

One of our greatest problems has been in getting men to use their heads for something other than hat racks—*to think.* This is especially true of new men.

New men are prone to apply safety measures to other than themselves, and the alert foreman proves his worth in directing and cautioning until unconsciously the men become safety minded.

In 1934, as a member of the National Safety Council, we entered the National Safety Contest and although we did not win an award several of our plants had no lost-time accidents in an average of 30,000 man hours' exposure at each plant.

safe working conditions and safe attitude on the part of all employees is a cold business proposition. It is a means of increasing efficiency and reducing costs. By costs we mean not only money saved on insurance and disability payments to injured workers, but the even more real cost which is the suffering, pain and anxiety that results from injury for which no amount of money can ever compensate.

ADJOURNMENT

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Edgar N. Goldstine, Consulting Safety Engineer, San Francisco, Calif.

John Russell, Jr., Public Service Electric & Gas Co., Newark, N. J.

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General Chairman—W. A. Snow, Associated General Contractors of America, Inc., Washington, D. C.

Vice-Chairman for Heavy Construction—R. J. Reigeluth, C. W. Blakeslee & Sons, New Haven, Conn.

Vice-Chairman for Highway Construction—H. G. Campbell, Harry T. Campbell Sons Co., Towson, Md.

Vice-Chairman for U. S. Engineer Department—Major H. B. Vaughan, Jr., Corps of Engineers, War Dept., Washington, D. C.

Vice-Chairman for Building Construction—C. H. BLACK, Stone & Webster Engineering Corp., Boston, Mass.
Secretary—ROBERT MCKINLEY, General Accident, Fire & Life Assurance Corp., Detroit, Mich.
News Letter Editor—L. K. REINHARDT, Industrial Accident Commission, San Francisco, Calif.
Engineering Committee Chairman—THOMAS SOULE, Industrial Indemnity Exchange, San Francisco, Calif.
Membership Committee Chairman—F. J. CRANDELL, Liberty Mutual Insurance Co., Boston, Mass.
Program Committee Chairman—JOHN RUSSELL, JR., Public Service Electric & Gas Co., Newark, N. J.
Statistics Committee Chairman—E. N. GOLDSTINE, 352 Funston Ave., San Francisco, Calif.
Visual Education Committee Chairman—S. M. LAUDERDALE, Civilian Conservation Corps, Washington, D. C.

TUESDAY AFTERNOON SESSION

October 12, 1937

The first session was called to order by Edgar N. Goldstine, consulting engineer, San Francisco, who acted as chairman in the absence of W. A. Snow.

Awards for No Lost Time Accident Record

By R. J. REIGELUTH

Vice President, C. W. Blakeslee & Sons, New Haven, Conn.

Our company has always maintained the policy of trying to make its employees into one large family. We have about forty men who have been in our organization over twenty-five years, and a large number who have been with us over fifteen years, some of these men growing up from water boys to superintendents.

As all contractors today are seeking means to check the increasing costs of material and labor, we were concerned about a further increase in the cost of our compensation insurance. While the insurance costs are only a part of the cost of a high accident record, they are an indication of how those costs are running. Most of us construction men do not record all of the costs of an accident in our cost books and do not know the cost involved in time lost by the associated workers of the injured man, the cost involved in replacing the injured man with another workman, the cost involved in replacing a broken machine or damaged piece of work; still we all know these costs exist and when our insurance rates increase, we get an idea of how those other costs are mounting up.

We made a thorough study of what was involved in our accident records and had conferences with two insurance companies who carry our compensation insurance. There were several jobs in our record which had operated without a lost time accident, including various typical kinds of construction work from operating a crushed stone quarry to reconstructing a bridge on which a pier had failed.

We determined what the saving in insurance costs would have been on the jobs which had a record of no lost time accident if we had been carrying the Retrospective plan of insurance on those jobs. This study showed that a job operating for a period of one year with no lost time accidents results in a saving of between \$2.50 and \$5 per \$100 of payroll, the saving being determined by the type of work. Six men working with one foreman 40 hours per week for 40 weeks amount approximately to 10,000 hours. If these men averaged 50c per hour the annual payroll for this crew would be \$5,000. If this crew operated through the year with no lost time accident, the saving at \$2.50 per \$100 of payroll would result in a saving of \$125 in the insurance for that period of time. It is obvious that with a foreman having a larger crew of men, the saving would be considerably more, and also that the saving would be considerably more on a hazardous piece of work where the compensation rate was high. We decided to share that saving with our men.

We set up for this first year the following plan of awards for a No Lost Time Accident Record:

We offer cash prizes of \$50 and \$25 to each foreman attaining the requirements for the award. The \$50 prize is awarded to any foreman who carries his gang through the calendar year with no lost time accident, and the \$25 prize is awarded to any foreman who carries his gang through the calendar year with no more than one lost time accident resulting in no more than one week of lost time. We established the second prize of \$25 to meet the possible situation of a foreman almost making the grade of a no accident record only to have it shot the last week by one accident. We wanted the men to feel that their honest efforts at safety had recognition even though they did not have a perfect score.

To qualify for these awards a foreman must be a man regularly employed on our payroll at least 40 weeks in one year. We place no requirement for a minimum amount of time that a foreman must work as a foreman in any one year. We figure each foreman's record on the same basis that the baseball leagues figure a player's batting average. We want results and if a man who gets to "bat" only once makes a "hit," he has a perfect score. If a foreman has a job for only one month or less and has a no accident record he has done the best that he could for the time we called upon him for performance.

I want to make that point plain. All construction men are faced with a problem of keeping their key men working all the time, and from time to time demote key men from positions as foremen to jobs in a gang when there is not work for the men as foremen. We have carried on work sometimes in periods of depression when almost every man on the job was of foremanship material. So that in an effort to avoid imposing any hardships on our men we classify those men as foremen and available for the awards who have been in our employ for a period of 40 weeks in a calendar year and used by us as foremen any time during that year.

We classify as a lost time accident any accident where the injured man is unable to return to work on the shift following the shift in which he was injured. An injured man may receive first aid treatment on the job or at a physician's office and may be off the job the larger part of the day in which the injury occurs, but if he is able to return to work on the next shift, we do not classify that accident as a lost time accident.

We put this plan into operation at one of the meetings of our superintendents and foremen. Our plan for meetings of this nature is to have a private dining room in the best hotel in our city to which we call the superintendents and first-class foremen from their jobs, wherever they may be located. In cases of jobs remote from our city, it is necessary for these key men to leave a job in the middle of the day to get to the meeting; but we consider these meetings of sufficient importance to warrant the effort and cost about once a month.

It has always been difficult to induce the foreman on a job to consider safety from a humanitarian point of view, and it is also difficult to get him to realize fully the costs involved in accidents to the company. But it is comparatively easy with a foreman, as with anybody else in the world, to point out the value of safety when it means \$50 in his own pocket. The foremen are showing a keener interest in safety than they ever have before, and have come to look upon an accident as a direct loss to themselves.

Throughout the competition for these awards we have not abated our efforts to assist our foremen and superintendents to secure as safe conditions as possible on our work. We have had meetings, not only of the foremen and superintendents, but also

By Hours of the Day
By Body Part Injured
By Nature of Injury
By General Cause
By major sub-classifications under General Cause
By Primary Basic Causes
By Secondary Contributing Causes
By Foremen in Charge
By Manner of Performance
By Agency (Machine, Material, etc.)
By Part of Agency
By Method of Contact

The figures may be summarized using days of time lost, medical expense, compensation awards, or other associated data.

WEDNESDAY AFTERNOON SESSION

October 13, 1937

Methods for Protection Against Silicosis, and When They Are Justified[1]

By DANIEL HARRINGTON

Chief, Health and Safety Branch, U. S. Bureau of Mines, Washington, D. C.

While the hysteria with regard to silicosis and other occupational diseases has largely subsided and this subject is being more carefully considered and soberly judged, it would be poor policy for any employer to maintain that the storm has ended and that he can relax and revert to conditions as they were some years ago. The fact is that the plan of paying occupational-disease compensation is now in its infancy and can be expected to grow rapidly.

At present while all the States of the Union, including the District of Columbia and excepting only Arkansas and Mississippi, have compensation acts, only the following make provision for occupational diseases to some extent: California, Delaware, Connecticut, District of Columbia, Illinois, Indiana, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, Washington, West Virginia, and Wisconsin.

Silicosis is compensable in one way or another in California, Connecticut, District of Columbia, Illinois, Kentucky, Massachusetts, Missouri, New York, North Carolina, North Dakota, Ohio, Pennsylvania, West Virginia, and Wisconsin, and possibly in other States. It will be surprising if comparatively comprehensive occupational-disease legislation is not on the statute books of nearly every state in the Union within the next five years.

With this situation confronting him, the farsighted industrialist who has the interest of his organization at heart will immediately start to "put his house in order" by studying possible occupational disease hazards to his employees and promptly applying known remedial measures or attempting to devise such measures if none exist. Unquestionably, one of the most important of the surveys to be made relates to dust occurrence.

While the state dust laws and regulations apply primarily to silica dust and resultant silicosis insofar as the health hazard is concerned, those most familiar with dust occurrence and its possible hazards recognize not only that the breathing of large quantities of dust of free silica (SiO) is probably the greatest hazard to health likely to be found where dust is involved, but that not even silica dust is harmful to health unless it occurs in very finely divided form and is breathed in relatively large quantities more or less continuously for a considerable length of time. Moreover, many thoughtful experts on dust harmfulness are now becoming convinced it is to be expected that health will be harmed when human beings are obliged to breathe high concentrations of any kind of dust more or less continuously. Professor Philip Drinker, of Harvard, as chairman of the Preventive Engineering Committee of the Air Hygiene Foundation, Pittsburgh, has expressed the considered opinion of a body of outstanding dust experts as follows:

"There is no satisfactory medical answer at present to this question, but the engineer is making a bad mistake if he lets men breathe heavy dust concentrations of any material. If no other reason for dust control can be found, then one should read transcripts of some of the recent suits at common law in which fantastic damages for alleged silicosis were granted to men who breathed dust containing little or no silica. The courts and compensation boards are not impressed with subtle distinctions between dusts with 10 per cent and 40 per cent quartz, especially when medical experts are reluctant to make definite statements as to the comparative significance of such differences.

"It would be well to realize that men working in dusty trades suffer far more from respiratory troubles of all kinds than do men who work in clean air. The evidence that excessive dustiness of any kind is harmful is beyond argument."

It should also be remembered that the inhaling of dust is by no means its only hazard in industrial work that may require compensation payment; and even here the harmful effect of breathing dust is not necessarily confined to the lungs, as some kinds of dust are known to have detrimental health effect on the nose, throat, and bronchial passages as well as (indirectly) on the heart, stomach, and possibly other internal organs. Externally, dust may cause injury to the eyes, ears, and skin; and some dusts, in contact with the perspiration, are absorbed with definite harm to the health of the victim.

Dust Cuts Visibility

Moreover, heavy concentrations of dust in the air reduce visibility materially. Obviously, in industrial occupations in which but limited amounts of natural light are available or in which artificial light is used entirely, any decrease in visibility due to dust concentrations (and the decrease in visibility may, under some circumstances, amount to 75 per cent or more) is likely to result in materially reducing efficiency and in the more frequent occurrence of accidents accompanied by an increase in compensation commitments. Some dusts (coal, aluminum, and scores of others, mineral and nonmineral) are explosive and many are subject to spontaneous combustion with consequent hazards to health, safety, and property. Many dusts have detrimental effects of various kinds on property as distinguished from persons. Machinery, growing vegetation, animals, dwelling houses, and other types of property are damaged by dusts, and compensation of some kind often is obtained from industrial concerns through damage suits or otherwise.

From the viewpoint of respiratory harmfulness, it is generally stated (though actually knowledge on this point is by no means certain) that the particle sizes of dust (such as that of free silica) that affect health adversely upon entering the lungs are those that are less than 10 microns in size, different persons having different ideas as to what the maximum may be—10 microns or 8 or 6, and some say that the harm really is done by particles less than 2 microns in size. As against this, it is stated that fibers of asbestos dust as long as 200 microns have been found in the lungs of men, and that undoubtedly these long asbestos fibers exerted at least some detrimental effect.

Since a micron is only about one twenty-five-thousandth of an inch, or much smaller than the naked eye can see, it is usually assumed that the larger dust particles that can be seen floating in air, and which settle out relatively fast are not harmful to health. Certainly, this is not so, as the larger particles that float in the air (some of them 100 or more microns in size), if present in considerable quantities clog the air passages to the lungs, some of which have agencies that under ordinary conditions intercept dust particles before they can reach the lungs and this clogging then allows the smaller and probably most dangerous dust to enter the lungs unimpeded.

A common-sense opinion as to what constitutes an atmosphere so dusty that dust-prevention action should be taken is that any atmosphere in which dust can be seen by the naked eye is too dusty, not only for health but also, at least in many cases, for safety and efficiency. If the visible dust is eliminated, much of the invisible or probably most dangerous dust will unquestionably have also been removed and very likely the health as well as other hazards much minimized or even removed.

After the visible dust has been removed, it may be necessary, under some conditions or with some types of dust, to make more in-

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tricate investigations as to the occurrence of invisible dust, using the impinger, konimeter, or other instruments; but unless litigation is in effect or threatened, those intricate studies are relatively unimportant if the visible dust is eliminated from the air of working places.

Prevention Is Best

Manifestly, if dust is not produced, it can't get into the air or become harmful otherwise; and some relief from dust troubles in industry can be achieved by using construction, practices, processes, or equipment that tend to eliminate dust formation.

In designing and equipping the places in which employees must work, the forward-looking industrialist will be wise to prevent the making of dust or to control it if it must be made, by using machinery, methods, processes and construction with dust-eliminating characteristics rather than those that produce or spread dust, even though some additional expense in construction or operation may attach to the dust-prevention features. The emphasis now being placed on dust in its various phases and the expense which dust may cause make it almost imperative that in the future much more thought be given to dust prevention and handling than has been given in the past.

For instance, processes or practices that produce excessive dust should be discarded for others that produce less dust, or they should be isolated somehow, such as by housing them tightly in a separate part of the plant or using them at times when the least number of persons would be exposed to them or when there is ample time to remove the dust from the atmosphere of the working places. Such installations or practices must be operated efficiently at all times, however. Common sense should be used in handling a dust control device or method; certainly it is foolish to use an elaborate exhaust system to take the dust out of part of an establishment and then exhaust the dust-laden air at such point or in such manner that it will be taken into the same or some other part of the establishment or into an adjacent one through doors and windows.

If dust must be formed, several effective methods are available to prevent the dissemination of dust into the air or into places where it may cause trouble. Among these are wet methods, such as wet drilling instead of dry drilling, wet crushing instead of dry crushing, wetting or washing down floors, walls, and rock faces. In general the use of water in industrial processes and otherwise is one of the most effective available aids in the prevention of air dustiness, even though in some cases wet drilling does give off some dust. Notwithstanding a growing tendency in some quarters to decry the effectiveness of wet methods, up to now the use of water is probably our best defense against dust dissemination, especially in mining and tunneling.

Dust-exhaust devices, such as hoods, traps for drilling, etc., have a definite place in dust control, particularly in surface plants and operations. Under some conditions exhaust systems, when well installed and kept in repair and operation, not only remove dust but also more than pay for themselves in dollars and cents value of recovered dust. It costs approximately $7,000 to install such a device in a surface plant processing one of the metals, and the value of the dust recovered daily averaged about $25. In addition, the device kept the air of the plant as well as the surrounding walls and other surfaces practically free of dust.

On the other hand, the use of dust traps in dry drilling, while definitely applicable to certain types of surface or near-surface rock-excavation work, has not been found applicable to general rock-drilling practice in underground work. There are several reasons for this, some of which may be overcome in time.

Some types of rock cannot be drilled dry with any degree of effectiveness, and as yet the available types of rock-drilling traps are not workable with wet drilling; if dry drilling can be done, the traps ordinarily will do a good job of removing the dust from drilling, but this will leave the rock surfaces (top, sides, and floor in many cases) dry, and subsequent operations (blasting, mucking, timbering, hauling, etc.) will throw into the air dust certain to be created in large quantities by the other processes. The dust thus thrown into the air will settle on dry surfaces, ready to be thrown into suspension subsequently by any or all activities. Dust traps are somewhat cumbersome, especially when used in the more or less confined places in mining and tunneling.

However, dust traps with dry drilling have definite applicability for use in surface or near-surface operations where dry drilling can be done, and have numerous advantages over wet drilling, especially in very cold weather.

Good Ventilation Needed

Ventilation is probably the most effective dust-control practice available for many industries, though it ranks second to wet methods in others. Where ventilation can be applied effectively, dust can be removed from the air or its concentration can be kept so diluted as to render it practically harmless to workers; ventilation can minimize dust hazards of almost all kinds, including spontaneous combustion, though it may enhance hazards of dust explosibility in some instances. In some cases ventilation should be induced by exhaust methods, but in others forced or blowing systems are the more effective, this being particularly true in underground work in places having high-temperature air due to rock or dripping water or other condition, such as rapid oxidation of surrounding rock or timber.

To obtain really effective ventilation in such work as tunneling and metal mining is difficult usually because ordinarily but one opening is driven instead of having workings in pairs as in coal mining, where fresh air flows in one opening and return or contaminated air in the other. Conditions brought about by dust may force the use of parallel openings in many tunneling and metal-mining operations of the future, and, notwithstanding the violent objections this suggestion will raise, there are good reasons for believing that in many cases there would be definite dollars and cents savings if the parallel-opening system, with its numerous ventilation, health, drainage, and other advantages, were used instead of the present one-opening system, with numerous disadvantages and hazards and with about its only real advantage the fact that its use is and has been customary.

Dry drilling is unquestionably the dustiest work in mining, tunneling and quarrying, and it continues to be used far too much in the United States; certainly, if dry drilling is allowed at all, it should be done only with auger twist drills or with the simultaneous use of up-to-date dust traps.

Wet drilling as practiced in the United States, with water forced or drawn through the drill steel by means of compressed air, is now under fire as producing relatively large quantities of dust even though the material floating in the air usually is wet; some of this criticism is undeserved but, some of it is legitimate. The trouble is due largely to the fact that the holes are collared or started dry and, in some cases at least, are drilled dry for several inches after starting, and the dust created by this dry starting impregnates the usually stagnant air of the ordinary underground-tunnel or metal-mine working place for much if not most of the working shift.

In some cases the driller drastically limits the amount of water sent through the drill steal and, while nominally drilling wet, the actual practice is closely analogous to dry drilling with compressed air, which flows through the drill steel and forces out of the drill hole and into the air of the working place undue quantities of water-entrained dust or particles. In some cases when the drill is out of repair, the driller allows far too much compressed air to flow through the drill steel.

When present types of wet drills are used properly, the dust from drilling can be kept within reasonable limits, and this is actually being done by numerous alert and conscientious mining and tunneling companies. Some companies in the United States and Canada are experimenting with rock drills that do not allow compressed air to go through the drill steel but require the water to be forced through the steel by its own pressure; such drills are said to produce less dust than the usual types in which water is sent through the steel by compressed air, but the practicability of the newer type of drill is questionable and it has been used relatively little in the United States or Canada.

Must Use Judgment

However, air dustiness can be kept well within safe limits if modern types of wet drills are operated with care and judgment in collaring wet with plenty of clean dirt-free water; if the drills are kept in good repair; if the proportion of water and compressed air flowing through the drill steel are adequately regulated; if the exhaust from the drill is prevented from impinging on nearby dusty surfaces of muck piles, floors, walls, or timbers thereby throwing dust into the air; and, if, insofar as feasible, the drilling of upper holes is reduced to a minimum, as upper holes, whether drilled dry or wet, are relatively heavy producers of dust in the air of working places.

Next to dry drilling, blasting causes more finely divided dust to be thrown into working places than anything else; and, in addition to throwing violently into the surrounding air immense quantities of finely divided dust, blasting with the heavy charges of explosive required in many mining and tunneling operations also impregnates the surrounding air as well as the muck piles with considerable quantities of poisonous gases, such as carbon monoxide, oxides of nitrogen and, in some kinds of rock, hydrogen sulphate and other dangerous sulphurous fumes, practically all of which occur in such quantities and percentages under some circumstances as to asphyxiate persons who may breathe them or to cause serious illness, often of a more or less permanent character. Many persons who have studied the incidence of dust disease are of the opinion that the breathing of even small quantities or percentages of extraneous or hamful gases, such as carbon monoxide, oxides of nitrogen, hydrogen sulphide, etc., inflames or otherwise adversely affects the respiratory organs, especially the lungs, and makes them much more easily and readily susceptible to harm from the breathing of dust particles.

Past blasting practice most certainly must be modified and reformed if the employer is to avoid heavy penalties in compensation and other charges due to the inclusion of legislation on occupational diseases (one being dust disease) in the laws of the various States. If at all feasible, blasting should be done at the end of the working shift or on an off shift, and the dust- and gas-laden air should be removed or thoroughly diluted before the men return to work.

Ventilation is, of course, an essential agency in cleansing the air where blasting has been done, but in addition to ventilating the place it should be thoroughly wetted (walls, floors, roof or top, timbers, etc.) before blasting is done, and a water blast should be kept in effect during and after the blasting; the region should be thoroughly wetted upon return to the face region after blasting, and the muck pile should be kept well wetted at all times while loading it out, as the water not only tends to allay the dust but also either absorbs or otherwise aids in the dilution or elimination of harmful or poisonous gases from blasting, which usually cling to the blasted material.

In general the larger the quantity of explosive used, the more finely divided the blasted material, the more heavily the air is impregnated with dust and smoke, and the greater the quantity of poisonous gases left at the places; hence, methods should be used which will tend to reduce the quantity of explosives used and of gases and dust produced. In this it will be found that the use of stemming or of some types of blasting plugs now available will more definitely confine the explosive; hence, increase its efficiency and reduce the quantity of explosive used and also reduce the amount of poisonous gas produced and possibly reduce the violence of the blast and its tendency to produce dust and disseminate it into the surrounding air.

And it would be well for users of explosives to investigate types of explosives that are known to give off minimum quantities of harmful gases on detonation and to use them; also the elimination of the use of fuse and the substitution of electric blasting would aid in reducing the amount of poisonous gases from blasting. Explosives that have been held in storage too long or that have been stored under unfavorable conditions as to moisture and temperature, are likely to give off maximum quantities of harmful gases if they detonate at all; hence, utmost care should be taken in the storage of explosives and to see that they are not held in storage too long before being used

Respirators Available

Dust respirators of various types are now available for use in excessively dusty atmospheres, and while they are cumbersome and have numerous features that make them undesirable for constant wear throughout a working shift (though they can be worn readily for several minutes at a time), they do give adequate protection to wearers against dust but give essentially no protection against either poisonous or asphyxiating gases. Dust respirators should be regarded as being temporarily useful for emergencies only, whereas protection for workers against dust should be more substantial.

What might be designated "good housekeeping" has a definite place in dust prevention. Dusty materials should be stored in dust-tight containers or bins; dusty processes, including the handling of dusty material, should be carried on, as far as feasible, in dust-tight compartments or structures, the tightness of which should be maintained; ledges or surfaces on which dust may lodge and accumulate, to be thrown into the air by some shock or movement, should be changed to prevent opportunity for such accumulation, or, if this cannot be done, such surfaces should be cleaned periodically by vacuum process, by washing down, or by sweeping (the latter being a relatively poor method, and should be employed only when as few of other workers as possible are present); floors should be kept as free of dust as possible preferably by washing them with water; and, certainly, air for the working places should not come from dusty sources.

Physical examinations should play an important part in the drive to minimize health harm from dust in industry, but so much controversy has been aroused because of them that their effectiveness has been largely nullified. Unquestionably, every person employed in an industry where considerable dust may be found in the air should be rigidly examined by a competent doctor previous to employment, and if the examination reveals the presence of respiratory trouble, the person should not be employed; this is especially true if tuberculosis is indicated. At six- or twelve-month intervals every person in dusty industry should submit to a rigid physical examination; and if disease is shown to be developing, the victim should be transferred to nondusty employment if such is available. Handling physical examinations in a manner fair to the worker as well as to the employer should be worked out, and it must be admitted that to date this has not been done at all adequately.

Prevention of dust disease is chiefly an employer responsibility he should shoulder willingly, not only to safeguard the health of persons in his employ but also to relieve his firm of the heavy financial burden likely to be thrust upon it by compensation or legal authorities, should employees become afflicted with dust disease; and when one takes into account how little is known as to the cause of the disease and how to relieve it if it is incurred, it would seem to be the acme of common sense to do anything practicable to reduce the dust content of the air of places where employees must work. This does not mean that the employee should not help himself, as it is manifestly as much to the interest of the employee to avoid dust or any other occupational disease as to avoid having accidents. However, information as to occupational disease (including dust disease) is not readily available to the worker in understandable form, and the employer should carry on an educational campaign to inform his safety and operating officials about occupational disease matters and to have them transmit the information to the workers so the latter can cooperate wholeheartedly in trying to eradicate these dread diseases from industry or at least control them to a far greater extent than has been done.

Safe Practices in Use of Heavy Construction Equipment

By E. A. BLANPIED

Safety Engineer of Kansas City Bridge Co., Kansas City, Mo.

My personal experience has been confined mainly to work of river improvement and bridge building. Our records are divided into these two classes.

River work consists of driving pile dikes and rip-rapping river banks, generally for the U. S. Government.

Bridge classification covers railroad and highway bridges of the heavier type including their foundations, both "pneumatic" and open dredged."

River work, being mainly done by floating plant and with a large percentage of unskilled labor, differs greatly from the more complicated bridge work which uses mostly skilled and semi-skilled labor under greater hazards.

The bridge classification is sub-divided into erection and foundation as each has its own special hazards and treatment.

River work has been the subject of extensive research along accident prevention lines by the U. S. Corps of Engineers and most of the fatalities are due to drowning. Special safety requirements to lessen this hazard have been compulsory by being

One of your local physicians will be pleased to talk to the employees on sickness prevention.

Carefully located bulletin boards with timely health topics are useful. Articles in plant magazines are far reaching, and pay-envelope inserts discussing health topics have proved beneficial.

ADJOURNMENT

Marine Section

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A. O. Woll, General Petroleum Corp. of Calif., Terminal Island, Calif.
John Wright, American Export Lines, New York, N. Y.

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General Chairman—E. C. Holden, Jr., United States P. & I. Agency, Inc., New York, N. Y.
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Logan Cresap, Isthmian Steamship Co., New York, N. Y.
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J. A. Rumsey, Standard Oil Co. of Calif., Richmond, Calif.
S. A. Schramm, Black Diamond Steamship Co., Pier K, Weehawken, N. J.
H. L. Seward, Yale University, New Haven, Conn.
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Major H. B. Vaughan, Jr., Corps of Engineers, War Dept., Washington, D. C.
L. H. Westdahl, Dollar Steamship Lines, San Francisco, Calif.
A. O. Woll, General Petroleum Corp. of Calif., Terminal Island, Calif.
John Wright, American Export Lines, New York, N. Y.

TUESDAY AFTERNOON SESSION

October 12, 1937

The opening session was called to order by Byron O. Pickard, Pacific American Steamship Assn., San Francisco, Calif., program chairman of the section. Captain E. C. Holden, Jr., United States P. and I. Agency, Inc., New York City, general chairman of the section, submitted a review of the year's activities.

The Advancement of Safety in the American Steamship Industry

By R. J. Baker

President, American Steamship Owners' Association, New York City

The advancement of safety at sea is the result of an endless process of trial and error. It is amusing to compare the present day attitude toward safety with the one of some eighty years ago, as indicated in an article published in the "Nautical Magazine and Naval Chronicle" of London in 1856, in which it was declared that the chief causes for loss of ships at sea are:

1. Teetotalism—the serving of coffee instead of rum;
2. The presence of the captain's wife and other women;
3. Insanity;
4. Drunkenness and revelry;
5. Mutiny and insubordination;
6. Discord and dissension;
7. No devil being on board;
8. The devil having been let loose.

Today our reliance on safety at sea is placed in the results of the navigation laws of the country; the ice patrol; study of ice and current conditions; load line and stowage regulations; removal of derelicts; installation of safety devices which provide the best available fire detection and extinction apparatus; constructive requirements which will enable an endangered ship to

Metals Section

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Engineering Committee Chairman—R. H. Ferguson, Republic Steel Corp., Cleveland, O.

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Contest Committee Chairman—Robert L. Schmitt, Louisville Car Wheel and Railway Supply Co., Louisville, Ky.
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R. A. Beyer, Central Tube Co., Ambridge, Pa.
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C. S. Craigmile, Belden Manufacturing Co., Chicago, Ill.
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C. A. Bianchi, H. H. Robertson Co., Ambridge, Pa.
H. W. Darr, Bethlehem Steel Co., Johnstown, Pa.
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Frank Rowe, Wheeling Steel Corp., Portsmouth, O.
A. C. Schultz, Bucyrus-Erie Co., So. Milwaukee, Wis.
J. A. Voss, Republic Steel Corp., Cleveland, O.

TUESDAY AFTERNOON SESSION

October 12, 1937

The session was called to order by General Chairman C. M. Allen, The American Rolling Mill Co., Middletown, Ohio, who introduced the speakers.

Safety as a Morale Builder

By ROY W. KELLY

Chief, Personnel and Training Division, Soil Conservation Service, Washington, D. C.

The maintenance of morale is readily conceded to be one of the major objectives of management. Whether the executive is responsible for building locomotives, making mattresses, managing a Government bureau, or commanding an Army division, his success is dependent in large upon keeping up the morale of his associates.

All of us tend to be influenced by, and to be upset and kept in a most unsatisfactory frame of mind by unsatisfactory living or working conditions. If we want high morale, we must expect to pay constructive attention to such matters as wages, hours, working conditions, basic causes for grievances and complaints, improvement of sanitation, elimination of unnecessary noise, and proper heating, lighting, and ventilation of the work place. Perhaps no other causes contribute more to lowered morale than a feeling of insecurity in one's occupation, fear as to the future of one's earning power and doubt as to opportunities for advancement and for satisfying achievement.

These are all recognized as matters properly belonging in the field of personnel administration or labor management. They are mentioned merely for the sake of pointing out that safety is an integral part of this functional field. Organization for accident prevention and the maintenance of the safety program, if they are to contribute to improved morale, must be planned and carried out with a view to their direct relationships with these other essential human factors in management. This is a point on which there is much diversity of opinion as well as practice.

Nevertheless, the experience of many organizations tends to indicate that a safety program cannot hope to succeed, no matter how well planned, unless conducted in an

On the basis of the human element being the major problem in the elimination of accidents and their attendant injuries, the safety program must be designed to emphasize to the supervision and workers the necessity of being safety-minded at all times. The most effective influence in selling any proposition is an appeal to the self-interest of the individual. If he becomes convinced that he can personally benefit by the elimination of accidents, he is apt to accept the safety program and become a safety booster.

The hazards incident to maintenance work can be minimized by methods which anticipate and reduce the number of breakdown jobs. This reduces the amount of work and corresponding man hour exposure, and allows most of the work to be done on a planned basis. The most essential practice in such a program is systematic, thorough and frequent inspection of all equipment, with a follow-up system which will insure that unsatisfactory conditions are corrected as promptly as production allows or economic considerations dictate.

If the maintenance foreman's territory is small this inspection can be made personally. However, the usual division of a steel mill maintenance foreman is too extensive and too many other demands are made upon his time to allow personal attention to all items of equipment. It is then necessary to delegate this important function to operators, oilers, engineers and electricians who are in a position to observe the condition of each piece of apparatus.

In power houses, boiler houses, pumping stations and similar station jobs the engineers, oilers, pump tenders and electrical operators are primarily occupied with operation of the equipment and close and continual observation is automatically obtained. Such close observation is accepted as necessary due to the importance to production and the fact that little spare capacity is provided. Likewise, the standard of maintenance is high, being kept as far as possible on a preventive basis. The jobs are usually well planned, the crews experienced and efficient, and all tools and special equipment at hand, resulting in efficient and safe performance.

The majority of mill auxiliary equipment does not get the same degree of attention and maintenance. Here the operator, in general, has no interest in the apparatus, except that it respond to the controls, and little or no responsibility for keeping the unit in operating condition—hence the necessary, fully organized maintenance crew to take care of such equipment. The only exception to this is the craneman who may have limited responsibilities as to the inspection, lubrication and adjustment of his machine, and certain other machine operators.

Overhead traveling cranes, gantry cranes, repair trolleys and various types of hoists comprise a class of equipment which require special attention from the standpoint of inspection and preventive maintenance. Due to the hazards of falling material, whether casual material, broken parts of the equipment, or loads dropped due to failure of mechanisms, every precaution must be taken to keep this class of equipment in good repair. It has been found desirable to supplement the work of the foreman and repairmen charged with the proper maintenance of such equipment by the use of Crane Inspectors.

The crane inspector goes over all equipment in detail, recording all items of a mechanical or electrical nature which need adjustment or replacement. This survey provides a double check and does not lessen in any degree the responsibility of the above-mentioned foremen and repairmen. Copies of these reports are forwarded to the superintendent and foreman involved, as well as to the Plant Safety Department head. All recommended repairs or alterations must be disposed of, either by being carried to completion, or by being rejected for cause.

The inspection covers cleanliness and orderliness of the equipment in the interest of minimized fire hazard and increased safety of operators and repairmen. Safety equipment, such as sanders, fire extinguishers, hand lines, safety belts, gongs, warning lights, light extension cords, gear guards etc. is checked. Loose or scrap material on the cranes, approaches or runways is not tolerated. Loose, worn or broken parts are itemized and recommended for correction.

Inspections at intervals of one to two months have been found sufficient for average conditions, with more attention given to particularly hard-worked cranes. Unusual operating conditions, or failures of parts may make it desirable for the inspector to make special checks and reports when requested.

ADJOURNMENT

Mining Section

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Fred E. Bedale, Consolidation Coal Co., Fairmont, W. Va.
John L. Boardman, Anaconda Copper Mining Co., Butte, Mont.
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H. T. Harper, Tennessee Copper Co., Copperhill, Tenn.
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V. O. Murray, The Union Pacific Coal Co., Rock Springs, Wyo.
R. B. Paul, New Jersey Zinc Co., New York, N. Y.
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L. T. Sicka, St. Joseph Lead Co., Bonne Terre, Mo.
John Treweek, Homestake Mining Co., Lead, S. D.

Officers Elected for 1937-38

General Chairman—G. J. Barrett, Oliver Iron Mining Co., Duluth, Minn.

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Vice-Chairman—Angus D. Campbell, McIntyre Porcupine Mines, Ltd., Schumacher, Ont., Canada.

Vice-Chairman—L. C. CAMPBELL, The Koppers Coal Co., Pittsburgh, Pa.

Secretary and News Letter Editor—DANIEL HARRINGTON, United States Bureau of Mines, Washington, D. C.

Poster and Slide Committee Chairman—J. J. FORBES, United States Bureau of Mines, Pittsburgh, Pa.

Publicity Committee Chairman—M. R. BUDD, The Explosives Engineer, Wilmington, Del.

Statistics Committee Chairman—W. W. ADAMS, United States Bureau of Mines, Washington, D. C.

Members at Large—

THOMAS ALLEN, Chief Coal Mine Inspector, State of Colorado, Denver, Colo.

J. W. ALT, Calumet & Hecla Consolidated Copper Co., Calumet, Mich.

P. M. ARTHUR, American Zinc Co. of Tennessee, Mascot, Tenn.

FRED E. BEDALE, Consolidation Coal Co., Inc., Fairmont, W. Va.

JOHN L. BOARDMAN, Anaconda Copper Mining Co., Butte, Mont.

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C. W. GIBBS, Harwick Coal & Coke Co., Pittsburgh, Pa.

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H. C. HENRIE, Phelps Dodge Corp., Bisbee, Ariz.

RUSH N. HOSLER, Coal Mine Section, Pennsylvania Compensation Rating & Inspection Bureau, Harrisburg, Pa.

C. F. KECK, Jamison Coal Corp., Greensburg, Pa.

THOMAS E. LIGHTFOOT, The Koppers Coal Co., Pittsburgh, Pa.

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V. O. MURRAY, The Union Pacific Coal Co., Rock Springs, Wyo.

R. B. PAUL, New Jersey Zinc Co., New York, N. Y.

JOHN T. RYAN, Mine Safety Appliances Co., Pittsburgh, Pa.

L. T. SICKA, St. Joseph Lead Co., Bonne Terre, Mo.

JOHN TREWEEK, Homestake Mining Co., Lead, S. D.

TUESDAY AFTERNOON SESSION

October 12, 1937

The session was called to order by General Chairman C. W. Gibbs, Harwick Coal and Coke Co., Pittsburgh, Pa., who introduced the speakers.

The Relationship of Safety to Efficiency in Mining

By JAMES K. RICHARDSON

Safety Director, Climax Molybdenum Company, Climax, Colorado

No person will deny that there can be but two ways of doing work—a right way and a wrong way. The whole scheme of mining methods is basically a question of safety and efficiency. If the ore cannot be extracted economically the system is abandoned. If the ore cannot be extracted without endangering the lives of the employees the system is abandoned. Unquestionably the latter though has often been overlooked. We cannot, however, overlook the fact that anything that kills or maims men is morally wrong. Furthermore, if our process or method tears up machines it is surely not efficient.

Low cost production is the true basis of efficiency. The major item on any cost sheet is labor. A property that achieves a low unit cost due to a cheapness acquired by low wages with the consequent low type personnel will not long exist! The reason is obvious—although the daily labor cost is low the ultimate job cost is high. These poor workers are the men that efficient organizations refuse to tolerate—the "cream of the crop" are hired in their place.

When a mine gets a reputation for unsafe working conditions you will notice an influx of poor workers. The good men leave—the poor ones stay. The reason is that the poor worker realizes he cannot get work in an organization that demands efficiency and ability. Each of us has talked to various employees coming from other properties. You hear that "such and such" a company kills men daily, or that someone is always getting hurt. These reports may or may not be exaggerated—but where there is smoke there is fire! If your property gets such a reputation among the laboring men LOOK OUT.

The basic principles of accident prevention are: Supervision, education, and discipline. It is not necessary to discuss these principles. However, it is true that too much of each day's work is lost by the working men, due to unsafe conditions. If the workman must spend half his day remedying faulty conditions, replacing staging left by a previous shift, "blowing out" his working place, or any one of a thousand similar circumstances, you know production costs are rising.

The efficient mining organization is today standardizing every task. These standards are built up from the study of the task and are adopted if efficient and safe. Such jobs are easily supervised and it is easy to educate the employee in the manner of working. When an employee knows how to do a job he seldom is injured!

From my personal standpoint I believe that the standardizing of jobs is the biggest step an organization can make toward improving underground or surface efficiency. I also believe that on the standard tasks the accident risk has been lessened 50 per cent. Every task is done the same way yet there is enough variation of conditions in mining practice so that it does not tolerate a man becoming mechanical. When a workman knows he must keep a definite standard regardless of the work being done, he attempts to meet those requirements. He knows that the preceding shifts must meet the same requirements and therefore he is able to take up his work safely, exactly where it was left by his predecessor. He can thus devote his full time to work without fear of slipshod methods applied previous to his arrival.

I believe that a task well done, regardless of the job, is more easily maintained than a haphazard piece of construction. When a job is safe, all components of that job are in first class condition. We can, then, surely count on lower maintenance costs on first class jobs and when the operator looks over his cost sheets, repair costs are the major items. All of us have seen timbermen tearing out old timber and replacing with new. Had this timber been properly placed and properly considered at first, the new job would not have been necessary.

Unquestionably we have all had experience with faulty ventilation. I recall certain underground fires that could have been controlled and loss of life averted had ventilation been considered a major problem in the original layout. The major portion of our small metal mines are notoriously poorly ventilated. Many men are "gassed," causing them to fall from high raises to death or certain injury; others contract pulmonary diseases more readily and are disabled. Some are injured because of their inability to see their work clearly. These things are all due to a faulty ventilating condition, and any injury causes certain losses in production regardless of its seriousness; nor can it be denied that unless breathable air is available the normal efficiency of employees is decreased.

In one particular property I recall certain additional work obtained merely by establishing proper ventilation. A total of 150 machine shifts was being put in each day in a stoping area and prior to correct ventilation the average amount of hole drilled per machine was 86 feet. After the ventilation was improved the average was increased to 118 feet. Loaders who had originally pulled approximately 76 cars consistently passed the 100 mark. Footages in development work rose from 2.6 per machine to 3.8 feet. Loss of time from pulmonary disorders dropped to a negligible figure, and the accident frequency fell 28 per cent.

Another important factor in accident prevention is correct illumination. Those mines which have done away with the old carbide the mine superintendent and heads of the employment and safety departments.

Each accident is analyzed and entered on the workman's safety record which shows at a glance, not only the accidents that he has sustained and the action taken, but also the educational training he has received and the protective equipment with which he has been provided such as goggles, gloves, safety hats, lamps, safety belts and other similar articles which are furnished by the company free of charge, and exchanged without cost to the workmen when rendered unfit by normal wear.

The safety work of the mining department is under the direction of a safety engineer, who has under him a corps of trained inspectors who make an inspection of all working places on each shift, and supervise general blasting operations. Dangerous conditions are reported immediately to the boss in charge of the work, and in urgent situations the inspectors have authority to stop the work until the place has been inspected by the boss, who then assumes all further responsibility. Typewritten reports are distributed daily by the safety department to all the bosses concerned, and at the weekly meetings of supervisors a check is made on the action taken on the recommendations that have been submitted.

As a stimulus to greater interest and co-operation in the prevention of accidents, a scale of monthly safety bonuses, payable to all bosses and inspectors has been established. This scale is based on the total rate of accidents per thousand shifts supervised, and takes into account the interest displayed during the month by each supervisor in the elimination of hazards, enforcement of safety rules, and good housekeeping.

Once each month all the working places of the mine are inspected by sectional safety committees, who make a detailed report of the conditions and equipment considered to be unsafe. Typewritten copies of these reports are distributed to all the foremen and bosses concerned for their investigation and written comments, and the discussion of questionable recommendations is taken up at a monthly meeting of the committees, bosses, foremen and mine officials.

Separate meetings of the contractors working in the two main divisions of the mine are held once each month, and the accident record of the preceding month is discussed with them in detail, adopting all possible measures for the prevention of similar recurrences.

Two meetings of the general safety committee comprising the management, operating executives, technicians and principal assistants: one for the surface departments and the other to cover mining operations, are held once each month for a review of the record of the previous month, and for the discussion of matters of general nature.

Fire Prevention

Every possible effort is made to minimize the danger of a fire underground. In preparation for such a contingency a large number of carefully selected men have been trained in the use of oxygen breathing apparatus, and five crews of five men each are kept in continued training. A smoke room has been provided to make the training more effective, and fire-drills are held underground in various sections of the mine once a month. An up-to-date first-aid and mine-rescue station is maintained on the main patio of the mine, completely equipped with 12 McCaa oxygen breathing apparatuses; 10 all-service gas masks; 50 self-rescuers; oxygen pump; carbon monoxide detector; safety lamps; stretchers of various types; life line, and other miscellaneous equipment.

A fire-car fully equipped with hoses, axes, pipe fittings, fire extinguishers, first-aid supplies, and other tools and material is also available on the main mine patio at a moment's notice. Provisions for an abundant supply of water in all parts of the mine through both air and water lines have been made, and water connections, hydrants, and fire extinguishers have been placed in convenient parts of the mine. An injector installed on the main air line at the portal of the mine is available to spread, by means of a stench signal, the warning of a fire underground.

ADJOURNMENT

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Don E. McDowell, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
Arthur Murray, Container Corporation of America, Chicago, Ill.
H. G. Noyes, Oxford Paper Company, Rumford, Me.
J. J. Plzak, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
Samuel Pruyn, Finch-Pruyn Co., Inc., Glens Falls, N. Y.
B. D. Rogers, Bird & Son, Inc., East Walpole, Mass.
F. H. Rosebush, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
S. F. Shattuck, Kimberly-Clark Corp., Neenah, Wis., Representative, The American Paper and Pulp Association.
L. R. Simpson, The Brown Paper Mill Co., Inc., West Monroe, La.

Officers Elected for 1937-38

General Chairman—George J. Adams, International Paper Co., Glens Falls, N. Y.

Vice-Chairman in Charge of Membership—Arthur E. Winslow, Hollingsworth & Whitney Co., Waterville, Me.

Secretary and Program Committee Chairman—F. A. Robinson, Kimberly-Clark Corp., Neenah, Wis.

News Letter Editor and Publicity Committee Chairman—Clayton Braatz, Marathon Paper Mills, Rothschild, Wis.

Contest Committee Chairman—A. Scott Dowd, The Paper Industry, Chicago, Ill.

Engineering Committee Chairman—D. B. Chant, The Ontario Pulp & Paper Makers' Safety Assn., Toronto, Ont., Canada.

Health Committee Chairman—Dr. Edward W. Paine, Hollingsworth & Whitney Co., Waterville, Me.

Poster Committee Chairman—J. H. Turner, Consolidated Paper Corp., Ltd., Grand Mere, P. Q., Canada.

Statistics Committee Chairman—Fred W. Braun, Employers Mutuals, Wausau, Wis.

Members at Large—

Ernest Augustus, The Mead Corporation, Chillicothe, O.
M. W. Dundore, Beloit Iron Works, Beloit, Wis.
K. L. Faist, The Champion Paper and Fibre Co., Hamilton, O.
W. A. Gleason, Hammermill Paper Co., Erie, Pa.
E. E. Grant, The Crystal Tissue Co., Middletown, O.
J. J. Hastings, Port Huron Sulphite & Paper Co., Port Huron, Mich.
C. O. Holmer, Minnesota and Ontario Paper Co., Minneapolis, Minn.
F. L. Irvin, St. Croix Paper Co., Woodland, Me.
D. A. McAlary, Fraser Companies, Ltd., Edmundston, N. B., Canada.
Don E. McDowell, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
Arthur Murray, Container Corporation of America, Chicago, Ill.
H. G. Noyes, Oxford Paper Company, Rumford, Me.
E. W. Patton, The Lawrence Paper Co., Lawrence, Kansas.
J. J. Plzak, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
Samuel Pruyn, Finch-Pruyn Co., Inc., Glens Falls, N. Y.
B. D. Rogers, Bird & Son, Inc., East Walpole, Mass.
F. H. Rosebush, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
S. F. Shattuck, Kimberly-Clark Corp., Neenah, Wis., Representative, The American Paper and Pulp Association.
L. R. Simpson, The Brown Paper Mill Co., Inc., West Monroe, La.

MONDAY AFTERNOON SESSION

October 11, 1937

The opening session of the Paper and Pulp Section was called to order by George J. Adams, International Paper Company, Glens Falls, New York, who presided.

Chairman Adams: Following the usual practice, it is my duty as General Chairman to review briefly the activities and progress of the Paper and Pulp Section during this past year.

There were two meetings of the executive committee during the year, the first at Chicago on January 19 and the second in New York City on April 15.

At the Chicago meeting, the principal topic of discussion was the program for this Kansas City Convention.

The New York meeting was concerned with a discussion relative to the correlation of efforts of this Section with other agencies or associations of the Industry in their aims to promote accident prevention in pulp and paper mills. Also included in the New York meeting was an extensive discussion on accident statistics. It was proposed that the Section take some means of perfecting and continuing these statistics because of the very pronounced interest being shown by a number of mills. Accordingly, a committee was appointed at the New York meeting consisting of Fred Braun, Chairman, Ernest Augustus, Arthur Winslow, George Burns and myself to act as a sub-committee to the regular statistics committee, of which Mr. Braun is also our Chairman, to consider the following:

1. Improvement of the present form of report of accident.
2. Perfecting a plan for future tabulation.
3. Perfecting a plan for the presentation of the statistics to the Section.

I have asked Mr. Braun to include in his statistical report also the report of this committee.

There has been quite an increase in the membership of our Section the past year. About 25 per cent of the industry as a whole are now members of the National Safety Council.

Through the good will of Fred Robinson and the Kimberly-Clark Corporation we have the services of a stenotypist to take discussion notes at our meetings here. We certainly are all appreciative to Fred and his corporation for this.

J. J. Plzak (Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.): I would like to ask that the membership give the Secretary permission to record a unanimous vote of appreciation for the splendid leadership that this Section has had under our Chairman, George Adams.

(The motion was carried.)

Report of Accident Experience Exchange

By FRED W. BRAUN

Manager, Safety Engineering, Employers Mutuals, Wausau, Wis.

Statistics should be used in your accident prevention work for fact-finding interest on your program. These can be shifted in any manner. Some very interesting things are brought out in this year's report.

Members of the Section are to be complimented on their response in sending in their reports. We received 678 reports this year as compared to 108 last year.

This year August, with 77 accidents, was the high accident month; July, with 29, low.

In Tabulation 2, which indicates the day of the week in which these accidents were caused, you will find that Wednesday was high, with 119, and Sunday was low. In '36 Sunday was low and Thursday was high. There is apparently an indication there that the middle of the week is high.

You should check with your own plant experience and see whether the accidents as they are reported to your plant check with this. Do you have the high recording in the middle of the week?

Tabulation 3 shows the day or shift. The day worker is low and the shift worker high. Does that mean that the day worker, working eight hours a day, during the day, every day in the year, has more natural rest, and that the shift worker who goes on at eleven to three or from three to eleven and so on, one week, and next week some other hours, has his rest broken up? When a man comes home at seven o'clock in the morning from a night shift, or three o'clock, does he go to bed and get his rest? If so, does he get natural rest? Those are some of the things you should check with your own plant.

Tabulation 4, time of accidents, is very close. There is very little difference between afternoon and morning accidents in recording.

Tabulation 5 shows that for the three years, '35, '36 and '37, the highest peak in the morning occurred anywhere from eight to twelve o'clock. Here is your first somewhat consistent fact. In the afternoon you

Petroleum Section

Officers 1936-37

General Chairman—A. W. BREELAND, Lone Star Gas Co., Dallas, Texas.

Vice-Chairman—A. J. MARTINSON, Union Oil Co. of California, Los Angeles, Calif.

News Letter Editor—J. H. BROWN, Tide Water Oil Company, New York, N. Y.

Engineering Committee Chairman—E. D. MURPHEY, Mid-Continent Petroleum Corp., Tulsa, Okla.

Health Committee Chairman—DR. V. C. BAIRD, Humble Oil and Refining Co., Houston, Texas.

Poster Committee Chairman—H. T. MARKEE, Phillips Petroleum Co., Bartlesville, Okla.

Program Committee Chairman—R. B. ROAPER, Humble Oil and Refining Co., Houston, Texas.

Publicity Committee Chairman—GLENN BYERS, Shell Petroleum Corp., St. Louis, Mo.

Statistics Committee Chairman—J. W. MYERS, Standard Oil Co. (N. J.), New York, N. Y.

Atlantic Division Chairman—R. L. SIMPSON, The Texas Company, New York, N. Y.

Great Lakes Division Chairman—F. R. McLEAN, Socony-Vacuum Oil Co., Inc., White Star Div., Detroit, Mich.

Gulf Division Chairman—D. B. HIATT, Texas Pacific Coal & Oil Company, Fort Worth, Texas.

Mid-Continent Division Chairman—KRAUS EARHART, The Texas Company, Tulsa, Okla.

Pacific Division Chairman—L. K. BUTLER, Union Oil Company of Calif., Los Angeles, Calif.

Rocky Mountain Division Chairman—B. V. OSBORN, Standard Oil Co. (Ind.), Casper, Wyo.

Past General Chairmen—

- R. W. BLACK, Standard Oil Co. of N. J., Elizabeth, N. J.
- R. S. BONSIB, Standard Oil Co. (N. J.), New York, N. Y.
- V. R. CURRIE, The Texas Company, Houston, Texas.
- R. E. DONOVAN, Standard Oil Co. of Calif., San Francisco, Calif.
- C. L. HIGHTOWER, United Gas System, Houston, Texas.
- G. O. LOCKWOOD, The Empire Companies, Bartlesville, Okla.
- GEO. F. PRUSSING, Union Oil Co. of Calif., Los Angeles, Calif.
- R. B. ROAPER, Humble Oil and Refining Co., Houston, Texas.
- E. J. SENNE, Socony-Vacuum Oil Co., Inc., New York, N. Y.
- C. W. SMITH, Standard Oil Co. (Ind.), Chicago, Ill.
- D. J. WALLACE, Sinclair Prairie Oil Co., Tulsa, Okla.

Secretary—H. N. BLAKESLEE, American Petroleum Institute, New York, N. Y.

Officers Elected for 1937-38

General Chairman—H. W. BOGGESS, Sinclair Prairie Oil Co., Tulsa, Okla.

Vice-Chairman—J. H. BROWN, Tide Water Associated Oil Co., New York, N. Y.

News Letter Editor—F. R. McLEAN, Socony-Vacuum Oil Co., Inc., White Star Div., Detroit, Mich.

Engineering Committee Chairman—E. D. MURPHEY, Mid-Continent Petroleum Corp., Tulsa, Okla.
Health Committee Chairman—P. E. KEEGAN, Shell Petroleum Corp., Houston, Texas.
Program Committee Chairman—A. W. BREELAND, Lone Star Gas Co., Dallas, Texas.
Publicity Committee Chairman—J. L. RISINGER, Magnolia Petroleum Co., Dallas, Texas.
Statistics Committee Chairman—J. W. MYERS, Standard Oil Co. (N. J.), New York, N. Y.
Visual Education Committee Chairman—C. A. MILLER, The Texas Co., Houston, Texas.
Atlantic Division Chairman—L. C. WOODBRIDGE, Socony-Vacuum Oil Co., Inc., New York, N. Y.
Great Lakes Division Chairman—R. T. HENDERSON, Standard Oil Co. of Ohio, Cleveland, Ohio.
Gulf Division Chairman—WM. GRANT, JR., Humble Oil & Refining Co., Baytown, Texas.
Mid-Continent Division Chairman—J. D. McCAMEY, JR., The Carter Oil Co., Tulsa, Okla.
Pacific Division Chairman—C. J. NOBMANN, Shell Oil Co., San Francisco, Calif.
Rocky Mountain Division Chairman—R. O. TRAYLOR, Standard Oil Co. (Ind.), Casper, Wyoming.
Past General Chairmen—
R. W. BLACK, Standard Oil Co. of N. J., Elizabeth, N. J.
R. S. BONSIB, Standard Oil Co. (N. J.), New York, N. Y.
A. W. BREELAND, Lone Star Gas Co., Dallas, Texas.
V. R. CURRIE, The Texas Company, Houston, Texas.
R. E. DONOVAN, Standard Oil Co. of Calif., San Francisco, Calif.
C. L. HIGHTOWER, United Gas Pipe Line Co., Houston, Texas.
G. O. LOCKWOOD, Cities Service Oil Co., Bartlesville, Okla.
GEO. F. PRUSSING, Union Oil Co. of Calif., Los Angeles, Calif.
R. B. ROAPER, Humble Oil and Refining Co., Houston, Texas.
E. J. SENNE, Socony-Vacuum Oil Co., Inc., New York, N. Y.
C. W. SMITH, Standard Oil Co. (Ind.), Chicago, Ill.
D. J. WALLACE, Sinclair Prairie Oil Co., Tulsa, Okla.
Secretary—H. N. BLAKESLEE, American Petroleum Institute, New York, N. Y.

MONDAY AFTERNOON SESSION

October 11, 1937

The session was called to order by General Chairman A. W. Breeland, Lone Star Gas Co., Dallas, Texas, who introduced the speakers and directed the discussion.

Industry's Responsibilities in Community Safety

By HENRY W. BOGGESS

Superintendent of Safety, Sinclair Prairie Oil Company, Tulsa, Okla.

During 1936 111,000 American citizens died in accidents. Sixteen per cent, or 18,000 of them, met death while employed at occupations from which they earned their livelihoods and so are called *industrial* fatalities. The remaining 93,000 accidental deaths are broadly referred to as *public* fatalities; at least, they were non-occupational.

The ratio of public to industrial deaths is more than six to one. It is obvious that the broadest need for safety is outside and not within the ranks of industry. Whether or not industry has any responsibility for these public or outside accidents, whether or not it has within its power the ability to prevent any of them, is the question.

That there is a close relationship between accident causes classed as public and those classed as industrial is recognized by all students of the subject. That relationship causes one to ponder over the right and the wrong of arbitrarily segregating industrial and public accidents. Safety men have long realized that the fundamental causes of industrial accidents differ not at all from those that kill people in the home, on the street or at the seashore. If hazardous equipment leads to injury in the plant, it will lead to the same thing on the highway or in the home.

From the standpoint of society at large there can be no basic difference between giving a green and wholly untrained industrial worker a well guarded jointer to operate and giving a green and wholly untrained citizen a modern, safe motor vehicle to operate. Trouble is potential in either instance; irretrievable loss is imminent in either case. The question should not be, "Who is responsible?" —the question should be, "Why are such foolish things done?"

It does seem that a united front should be brought to bear upon the fundamental causes of accidents as a whole; not entirely in lieu of, but at least in connection with, the many piecemeal thrusts and parries at contributing causes that are now flying in all directions. It is altogether probable that a closely knit and well organized one-front safety movement will appear on the horizon eventually.

It is readily granted that certain necessary legislation must come if safety is to grow more efficient. The Uniform Vehicle Code is an outstanding example of the right kind of legislation. Much necessary legislation will indeed be sponsored and fought for by safety men. But all such legislation must be sound and based upon scientific knowledge of the subject.

Aside from industrial safety men devotedly entering the so-called public accident field, just what else can industry do to help minimize accidents outside its gates? Just what are industry's responsibilities which it has not yet recognized and accepted?

One critical view is that the so-called technological development in this country, to which so many of our ills have been charged, is the result of research and development by American industry. It is said that through this research and development, the entire social tone of America has been changed from a Beethoven sonata to a Duke Ellington swing. To attempt to free industry from responsibility in even the more remote reactions due to this increased national tempo would be difficult—if it could be shown that industry had both the antidote and the authority to administer it.

The thought seems to be that, having changed the environment in which men live, it would follow as a logical sequence that industry should so train men that they can live securely in that changed environment. The answer to such a charge is not difficult: The limits to which industry may go in training humans to safely use its products are very well defined by the liberties that society grants to its citizens. Factual information, detailed instructions and pointed warnings just about exhaust industrial limits. Persuasion is possible but coercion is impossible. Mandatory requirements must be left to society.

But there are criticisms that are more practical and less idealistic. It has been suggested that the individual consuming the product of industry is entitled to as much protection in its use as is the workman in its making. Unless industrial safety is a mere monetary gesture, unless it was devised and is being maintained for purely economic reasons, this thought must be accepted as true.

What right has industry to sell a farmer a water pump with unguarded gears that will sooner or later mangle his hand? What right has industry to sell a housewife a porcelain bathroom fixture that is known to frequently break and sever arteries? What right has industry to sell a road commission an asphalt road that will be slick in wet weather and result in broken necks and broken hearts?

If the water pump can be guarded; if the bathroom fixture can be made of non-breakable material; if the asphalt road can be built so that it will not be slick in wet weather, then industry should not be permitted to plead economic or competitive pressure, nor even the value of replacement business.

It will not even attempt to do so when the time comes that the accident problem is looked upon as one problem and the safety efforts of America are united in a one-front, efficient drive to stop preventable accidents without regard to where they occur.

In a few quarters, industry yet covers up behind the old English Common Law principle known as "caveat emptor" which means, "Let the buyer beware." But this is rapidly being recognized as poor morals, poor ethics hospitals where air conditioning is installed, the doctors and nurses are comfortable, which tends to promote a steadiness of the nerves. The freedom from perspiration avoids the possibility of a wound infection from that source. Since some types of anesthetics are definitely known to have explosive characteristics, it is important to prevent the generation of a static condition that may prove disastrous. This is accomplished by maintaining a relative humidity of 50 per cent at which condition static is entirely eliminated.

In mines, air conditioning has been beneficial to the health and well being of the men working. In deep mines, without air conditioning, temperatures and humidities are excessive, which frequently cause prostrations. In shallow mines the roof and walls are at a temperature of approximately 50 degrees the year round and in the summer, when moist air is induced for ventilation, rapid condensation occurs and accumulates on the shale rock which increases the hazard due to falls. By supplying dehumidified air with a dewpoint equal to or below the shale rock temperature, moisture condensation will not occur, disintegration and falls are minimized.

Many air conditioning installations have been made in industrial plants where excessive process heat is generated, such as enameling rooms where materials to be enameled are at intensive temperatures. Air conditioning has reduced the number of prostrations and hence benefited the health and increased the comfort of the employees.

Another important application is the removal of dust and small particles of irritant chemicals, such as are found in unconditioned match factories, some departments of chemical, paints and pharmaceutical plants.

In the manufacturing of rayon, an acid solvent is required in the process. Unless an exhaust system is tied into the air conditioning system, the acid fumes contaminate the air, producing unhealthful working conditions. The fumes affect the throat and eyes in particular.

Fuse loading departments in ammunition plants is another application where air conditioning produces safety for employees. The humidity is kept high enough to prevent a static spark. Cooling and dehumidifying in summer eliminate perspiration from the worker's hands, which prevents the powder from adhering to the steel dies.

Some lacquering processes require a solvent having explosive properties. Since in some plants doing this type of work the solvent has explosive properties, and dehumidifying is required, an exhaust system is installed and sufficient outside air supplied to prohibit an explosive mixture.

Humidification in tobacco plants keeps down dust, which otherwise would be hazardous to employees. In the drying process of manufacturing matches, uniform drying, which requires air conditioning, prevents flaring or sparking when ignited.

ADJOURNMENT

Rubber Section

Officers 1936-37

General Chairman—J. M. KERRIGAN, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.
Vice-Chairman in Charge of Program—R. A. BULLOCK, Corduroy Rubber Co., Grand Rapids, Mich.
Secretary—R. W. MORSE, The Firestone Tire and Rubber Co., Akron, Ohio.
News Letter Editor—OLIVER HOPKINS, U. S. Rubber Products, Inc., Providence, R. I.
Engineering Committee Chairman—J. G. POLM, The Goodyear Tire and Rubber Co., Akron, Ohio.
Health Committee—
DR. W. S. ASH, U. S. Rubber Products, Inc., Detroit, Mich.
DR. J. NEWTON SHIRLEY, Arrow Mutual Liability Insurance Co., Watertown, Mass.
Membership Committee Chairman—PAUL VAN CLEEF, Van Cleef Brothers, Chicago, Ill.
Publicity Committee Chairman—W. H. MACKAY, Dunlop Tire & Rubber Corp., Buffalo, N. Y.
Statistics Committee Chairman—D. G. WELCH, Hewitt Rubber Corp., Buffalo, N. Y.
Members at Large—
RALPH S. FARNUM, U. S. Rubber Products, Inc., Detroit, Mich.
JOHN L. GRIDER, American Hard Rubber Co., Butler, N. J.
JOHN J. LOGE, The General Tire & Rubber Co., Akron, Ohio.
JOHN E. LOVAS, U. S. Rubber Products, Inc., Passaic, N. J.
URBAN L. MOLER, Inland Div., General Motors Corp., Dayton, Ohio.
W. P. SPANTON, American Hard Rubber Co., Akron, Ohio.
C. W. UFFORD, Ohio Rubber Co., Willoughby, Ohio.
Past General Chairmen—
E. W. BECK, U. S. Rubber Products, Inc., New York, N. Y.
A. M. DIETZ., Pennsylvania Rubber Co., Jeannette, Pa.
C. F. HORAN, Hood Rubber Company, Watertown, Mass.
J. T. KIDNEY, The Goodyear Tire and Rubber Co., Akron, Ohio.
H. W. LOW, Miller Rubber Products Co., Inc., Akron, Ohio.
W. L. SCHNEIDER, The B. F. Goodrich Co., Akron, Ohio.
CHARLES F. SMITH, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

Officers Elected for 1937-38

General Chairman—J. M. KERRIGAN, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.
Vice-Chairman in Charge of Program—R. A. BULLOCK, Corduroy Rubber Co., Grand Rapids, Mich.
Secretary—R. W. MORSE, The Firestone Tire and Rubber Co., Akron, Ohio.
News Letter Editor—OLIVER HOPKINS, U. S. Rubber Products, Inc., Providence, R. I.
Engineering Committee Chairman—J. G. POLM, The Goodyear Tire and Rubber Co., Akron, Ohio.
Health Committee—
DR. W. S. ASH, U. S. Rubber Products, Inc., Detroit, Mich.
DR. J. NEWTON SHIRLEY, Arrow Mutual Liability Insurance Co., Watertown, Mass.

Membership Committee Chairman—Paul Van Cleef, Van Cleef Brothers, Chicago, Ill.
Publicity Committee Chairman—W. H. MacKay, Dunlop Tire & Rubber Corp., Buffalo, N. Y.
Statistics Committee Chairman—D. G. Welch, Hewitt Rubber Corp., Buffalo, N. Y.
Members at Large—
Ralph S. Farnum, U. S. Rubber Products, Inc., Detroit, Mich.
John L. Grider, American Hard Rubber Co., Butler, N. J.
John J. Loge, The General Tire & Rubber Co., Akron, Ohio.
John E. Lovas, U. S. Rubber Products, Inc., Passaic, N. J.
Urban L. Moler, Inland Div., General Motors Corp., Dayton, Ohio.
W. P. Spanton, American Hard Rubber Co., Akron, Ohio.
C. W. Ufford, Ohio Rubber Co., Willoughby, Ohio.
Past General Chairmen—
E. W. Beck, U. S. Rubber Products, Inc., New York, N. Y.
A. M. Dietz, Pennsylvania Rubber Co., Jeannette, Pa.
C. F. Horan, Hood Rubber Company, Watertown, Mass.
J. T. Kidney, The Goodyear Tire and Rubber Co., Akron, Ohio.
H. W. Low, Miller Rubber Products Co., Inc., Akron, Ohio.
W. L. Schneider, The B. F. Goodrich Co., Akron, Ohio.
Charles F. Smith, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

THURSDAY AFTERNOON SESSION

October 14, 1937

The session was called to order by J. M. Kerrigan, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y., General Chairman of the section.

Rubber Section Safety Contest

Chairman Kerrigan briefly reviewed the outstanding facts in the 1937 Rubber Section Safety Contest.

Thirty-seven participating plants worked 63,696,394 man-hours during the six months' period of competition in the Rubber Section Contest and experienced 642 disabling injuries for an accident frequency rate of 10.079. The 37 plants employed 67,874 men. Both the accident frequency rate and man-hours of exposure were higher than for all previous contests.

Plants averaging 125,001 or more man-hours per month, composing Groups A and B, made the best records in the contest with an average frequency rate of 10.05.

Groups C and D, composed of plants with 125,000 or less man-hours of exposure per month, had an average frequency rate of 10.424. Two-thirds of the plants in both divisions had frequency rates below the averages.

Perfect records for the entire contest period were made by four plants. Seven of the 22 large plants in Groups A and B had frequency rates below 2.00 for the contest period.

Five plaques were awarded to winners of first place; two certificates were awarded to winners of second and third place.

Awards were presented by Lew R. Palmer, conservation engineer, Equitable Life Assurance Society, New York City, and past president, National Safety Council. Plaques were awarded to first place winners as follows:

Groups A and B—U. S. Rubber Products, Inc., Saugatuck Footwear Plant, Saugatuck, Conn.

Groups C and D (under 125,000 average monthly man-hour exposure)—Four tied for first place with perfect records—Van Cleef Brothers, Chicago; Providence Insulated Wire Co., Pawtucket, R. I.; The Lobl Manufacturing Co., Middleboro, Mass.; U. S. Rubber Products, Inc., Fabric Fire Hose Co., Sandy Hook, Conn.

"Rubber Industry Problems" was the subject of a round table discussion which touched on the following points:

1. What is a workable plan for good housekeeping?

2. What are the outstanding fire hazards? How can they be minimized?

3. How can hand tool injuries be prevented?

4. What protective apparel is necessary for the workers?

5. What types of mill and calendar safeties are most satisfactory? Why?

6. What hazards are involved in molding small rubber parts? How can they be overcome?

Safety Device for Horizontal Heater

By K. C. LOOMIS

Manager, Runningboard Div., The Ohio Rubber Co., Willoughby, Ohio

The need for a safety device for locks on the doors of horizontal vulcanizers, commonly called open steam heaters, was impressed upon us last year when a door blew off one of our largest heaters. The door, weighing more than a ton, was shot through the air like a paper plate. Luckily, no one was injured.

The operator couldn't explain what had happened. He was thinking about the spoiled job in the vulcanizer. We were thinking in different terms—how much more serious this could have been and what could be done to the heaters so that the steam could not be turned on unless the door was properly closed.

Not Fully Closed

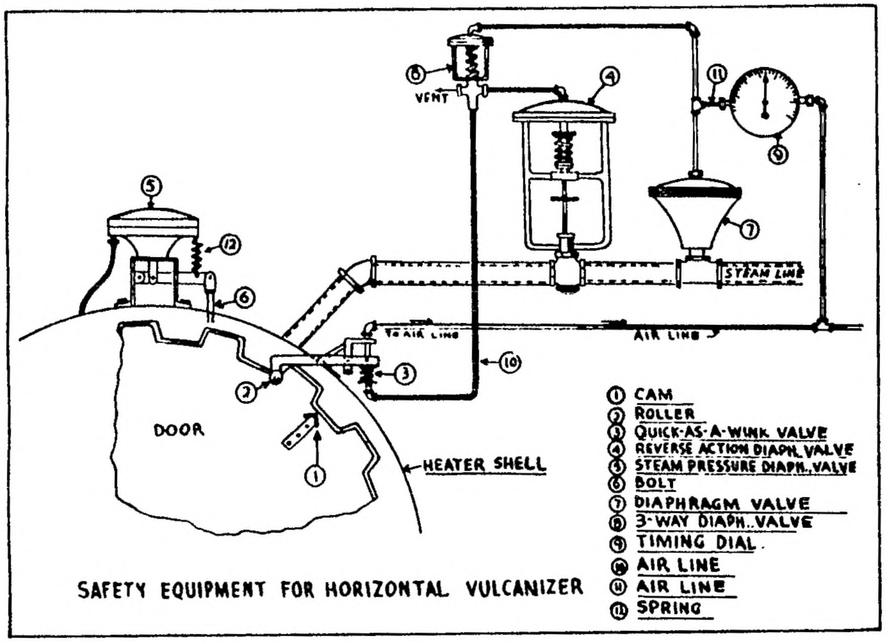
Examination of the door and the door locks exposed as the reason for the accident the fact that the door had been closed just enough to withstand nearly a full head of steam. As the pressure built up to this point, the door lug slipped back and the door blew open and off.

Positive Device Sought

The engineering division was instructed to correct this hazard, and if we were unable to buy a safety device, to make one. We found that there was no positive safety mechanism available which would make it impossible to turn on the steam if the door were not properly closed nor to open the door before the steam had been completely exhausted from the heater after the cure.

A safety device that will do just this has been developed and is now in use on all heaters in our plant at Willoughby, Ohio.

(Illustrating with a large copy of the drawing shown here, Mr. Loomis gave the following explanation of the device.)



SAFETY EQUIPMENT FOR HORIZONTAL VULCANIZER

Part I. Door is moved into position on heater and locked by turning door to the left. Cam (1) operates roller (2) opening valve (3) which releases air pressure to line (10) which leads to lower inlet of three-way diaphragm valve (8). Operator then sets cure time on time cycle regulator (9). This regulator automatically shuts off air pressure on line (11) allowing direct acting valve (7) to open. Shutting off the air on line (11) also operates three-way valve (8) which opens lower inlet allowing air pressure from line (10) to enter reverse acting diaphragm valve (4) opening same, and allowing steam to enter heater.

Part II. When heater is in operation, steam pressure built up inside of it will operate the diaphragm valve (5) pushing bolt (6) down behind door lug.

Part III. When cure time is up, time cycle regulator (9) turns air pressure into line (11) closing direct acting valve (7), also closing lower inlet of three-way diaphragm valve (8) which shuts air pressure from air line (10) and vents air from reverse acting diaphragm valve (4) causing this valve to close.

Part IV. As steam is exhausted from the heater and the pressure has reduced to less than 12 oz. on diaphragm valve (5), spring (12) will pull bolt (6) up, and heater door can be opened.

Note. (a) Tension on spring (12) can be adjusted either to raise or to lower the 12 oz. factor.

(b) Steam line has two valves, one closing with air pressure and the other closing with air off.

ADJOURNMENT

Safety Equipment Section

Accident Prevention Equipment Manufacturers Who Exhibited at the Twenty-Sixth National Safety Congress and Exposition

Kansas City, Mo., October 11-15, 1937

Exhibition Hall—Municipal Auditorium

Acme Protection Equipment Co., Inc., Pittsburgh, Pa.
Gas Masks.
Advertising Displays, Inc., Covington, Ky.
Safety Education Materials in Display Form With Moving Messages.
Aetna Casualty & Surety Co., Hartford, Conn.
Safe Driving Tests, Safety Educational Films.
A. S. Aloe Co., St. Louis, Mo.
First Aid and Hospital Equipment.
American Abrasive Metals Co., Irvington, N. J.
Safety Treads for Walkways and Safety Gratings.
American-LaFrance and Foamite Industries, Inc., Elmira, N. Y.
Fire Protection Equipment.
American Mutual Liability Insurance Co., Boston, Mass.
Insurance, Workmen's Compensation, Property Damage and General Automobile.
American Optical Co., Southbridge, Mass.
Head and Eye Protection Products.
American Safety Tank Co., Kansas City, Mo.
Automotive Fuel Supply Tanks.
Arntzen, Inc., Chicago, Ill.
Auxiliary & Emergency Stretcher First Aid Equipment.
Automatic Traffic Control Corp., St. Paul, Minn.
Traffic Actuated Control Equipment

Bear Manufacturing Co., Rock Island, Ill.
Safety Inspection and Correction Equipment.
Bendix Products Corp., South Bend, Ind.
Automotive Equipment.
Black-Sivalls & Bryson, Inc., Kansas City, Mo.
Safety Heads, Tanks and Pressure Vessels.
Bradley Washfountain Co., Milwaukee, Wis.
Group Washing Equipment.
Brown Shoe Co., St. Louis, Mo.
Men's and Women's Safety Shoes.
Stewart R. Browne Manufacturing Co., New York City.
Safety and Special Purpose Lights and Lamps.

R. H. Buhrke Co., Chicago, Ill.
Safety Equipment for Construction and Maintenance.
E. D. Bullard Co., San Francisco, Calif.
Personal Protective Equipment.
Burroughs Wellcome & Co., (U.S.A.), Inc., New York City.
First Aid Kits and Medical Equipment.

Champion Brake Corp., Chicago, Ill.
Hand Brakes for Freight Cars.
Chicago Eye Shield Co., Chicago, Ill.
Head, Eye and Respiratory Protective Equipment.
Columbus McKinnon Chain Corp., Tonawanda, N. Y.
Alloy Steel Sling Chains and Safety Hoists.
H. S. Cover, South Bend, Ind.
Respirators and Safety Goggles.
Crouse-Hinds Co., Syracuse, N. Y.
Traffic Signals and Floodlights.
M. E. Cunningham Co., Pittsburgh, Pa.
Safety Steel Stamps and Type Holders.

Davis Emergency Equipment Co., Inc., New York City.
First Aid and Industrial Safety Equipment.
C. H. Dockson Co., Detroit, Mich.
Head and Eye Protection.
DoMore Chair Co., Inc., Elkhart, Ind.
Posture-Health Chairs for Office and Factory.
Dual Parking Meter Co., Oklahoma City, Okla.
Parking Meter Equipment.
Donald F. Duncan, Inc., Chicago, Ill.
Parking Meter Equipment.

Eagle Eignal Corp., Moline, Ill.
Traffic Signals.
Electronic Control Corp., Detroit, Mich.
Electronic and Photo-Electric Equipment.
Elliott Service Co., New York City.
Promotion of Efficiency and Safety.
Emerson Drug Co., Baltimore, Md.
Bromo-Seltzer.
Employers Mutuals, Wausau, Wis.
Fire and Casualty Insurance, Workmen's Compensation.
Enameled Steel Sign Co., Chicago, Ill.
Day and Night Steel Reflecting Signs.

Fairway Laboratories, Inc., Belleville, Ill.
Anti-Fatigue and Heat Exhaustion Antidote Tablets and Dispensing Equipment.

Harley-Davidson Motor Co., Milwaukee, Wis.
Police Motorcycles and Accessory Equipment.
Hercules Friction Grip Co., Kansas City, Mo.
Brake Dressing.
Hild Floor Machine Co., Chicago, Ill.
Electric Floor Scrubbing Machines and Vacuum Cleaners.
Holcomb Safety Garment Co., Chicago, Ill.
Industrial Safety Clothing.
Hoof Products Co., Chicago, Ill.
Motor Vehicle Speed Control Governors.

Huntington Laboratories, Inc., Huntington, Ind.
Disinfecting and Sanitation Products.
Hynson, Westcott & Dunning, Inc., Baltimore, Md.
Mercurochrome First Aid Antiseptic, Thantis Lozenges.

Indian Motocycle Co., Springfield, Mass.
Police Motorcycles and Equipment.
Industrial Gloves Co., Danville, Ill.
Industrial Safety Clothing.
Industrial Safety Equipment Assn., New York City.
Association of Manufacturers of Industrial Safety Equipment.
International Shoe Co., St. Louis, Mo.
Safety Shoes.

Junkin Safety Appliance Co., Louisville, Ky.
Power Press Guards.
Juvenile Wood Products, Inc., Fort Wayne, Ind.
Automobile Safety Seats for Children.

The Karpark Corp., New York City.
Parking Meters.
Keystone View Co., Meadville, Pa.
Visual Safety Tests.
Walter Kidde & Co., Inc., New York City.
Fire Protection Equipment.
Kimball Safety Products Co., Cleveland, Ohio.
Industrial Safety Clothing and Supplies.

Lehigh Safety Shoe Co., Inc., Allentown, Pa.
Leather and Rubber Safety Shoes.
Liberty Mutual Insurance Co., Boston, Mass.
Automobile and Industrial Safety Service.

The Lima Cord Sole & Heel Co., Lima, Ohio.
Non-Slip Soles and Heels.
Lumbermens Mutual Casualty Co., Chicago, Ill.
Automobile, Compensation and General Casualty Insurance.

Macwhyte Co., Kenosha, Wis.
Wire Rope and Braided Wire Rope Slings.
The Martindale Electric Co., Cleveland, Ohio.
Dust Respirators and Highway Safety Signals.
McCloskey Torch Co., Toledo, Ohio.
Bomb Shell Torches and Truck Flares.
B. F. McDonald Co., Los Angeles, Calif.
Safety Hats and Respirators.
Metropolitan Life Insurance Co., New York City.
Life Insurance, Industrial, etc.
Michigan Malleable Iron Co., Detroit, Mich.
Traffic Stop Signs.
Milburn Co., Detroit, Mich.
Protective Creams for Prevention of Occupational Skin Diseases.
Mine Safety Appliances Co., Pittsburgh, Pa.
Safety Appliances and First Aid Materials.
Modern Engineering Co., St. Louis, Mo.
Welding Torches and Safety Goggles.
Murray Safety Sling Co., Inc., Pittsburgh, Pa.
Plated Wire Rope Slings.

National Bureau of Casualty & Surety Underwriters, New York City.
Safety Service, Casualty Insurance.
National Safety Council, Inc., Chicago, Ill.
Posters, Bureau of Information, Research and Education Division.

G. H. Packwood Manufacturing Co., St. Louis, Mo.
Soaps and Cleaning Compounds.
Panther-Panco Rubber Co., Inc., Chelsea, Mass.
Safety Soles and Heels.
The Patent Scaffolding Co., Chicago, Ill.
Safety Ladders and Scaffolds.
The Phister Manufacturing Co., Cincinnati, Ohio.
Fire Protection Equipment.
Protectoseal Co., Chicago, Ill.
Safety Devices for Hazardous Liquids.
Pulmosan Safety Equipment Corp., Brooklyn, N. Y.
Respiratory Protection and General Safety Equipment.

Railway and Industrial Engineering Co., Greensburg, Pa.
Interlock Systems, Potential and Phase Detectors, Insulator Testers.
Reece Wooden Sole Shoe Co., Columbus, Nebr.
Wooden Sole Safety Shoes.
Rich Signs Corp., Wichita, Kans.
Highway Reflecting Traffic Markers.
Rockwood Sprinkler Co., Worcester, Mass.
Fire Protection Equipment.
Rose Manufacturing Co., Denver, Colo.
Industrial Safety Equipment.

Safeguard Electric Co., Inc., Brooklyn, N. Y.
Shockproof Portable Lamp Guards.
Safety Engineering, Alfred M. Best Co., Inc., New York City.
"Safety Engineering," Insurance Publications and Reports.
The Safety Equipment Service Co., Cleveland, Ohio.
Goggles and All Types of Accident Prevention Equipment.
Safety First Shoe Co., Holliston, Mass.
Safety Shoes.
W. H. Salisbury & Co., Inc., Chicago, Ill.
Linemen's Rubber Protective Devices.
Shepherd Safety Shoe Corp., Chicago, Ill.
Safety Shoes.
The Spencer Turbine Co., Hartford, Conn.
Industrial Vacuum Cleaners and Dust Collection Equipment.
Standard Safety Equipment Co., Chicago, Ill.
Industrial Safety Equipment.
Stonehouse Signs, Inc., Denver, Colo.
Accident Prevention Signs and Tags.
The Strauss Co., Pittsburgh, Pa.
Safety Belts, Safety Hats, and Foot Guards.
Sugar Beet Products Co., Saginaw, Mich.
Industrial Soaps.
The Surety Rubber Co., Carrollton, Ohio.
Linemen's Safety Equipment and Synthetic Rubber Industrial Equipment.
The Surty Manufacturing Co., Inc., Chicago, Ill.
Dust Counters, Exhaust Units, Safety Guards and Shields.
S-W Supply Co., Girard, Kans.
Highway Railroad Signals.

Threeway Signal Co., Oklahoma City, Okla.
Safety Signal Equipment.
Traffic Boy, Inc., Canton, Ohio.
School Zone Traffic Warning Signs.

United States Steel Corporation Subsidiaries, Pittsburgh, Pa.
Steel Products and Cement.

Wahlert Products Corp., Brooklyn, N. Y.
Industrial Safety and Fire Protection Equipment.
Weaver Manufacturing Co., Springfield, Ill.
Automotive Testing Equipment.
West Disinfecting Co., Chicago, Ill.
Products for the Promotion of Industrial Sanitation.
The Western Union Telegraph Co., Kansas City, Mo.
Communication Service.
Willson Products, Inc., Reading, Pa.
Personal Protective Devices.

The session closed with a panel discussion on wood products mill safety.

Among the points mentioned were the following:

The need of educating the worker in simple terms; the necessity of personal contact in safety education; giving reasons instead of simply orders; the seriousness of minor injuries; safety meetings of supervisors and employees.

ADJOURNMENT

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