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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

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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 200-300 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.[4] 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.[4]

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.[1]

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.[1]

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.[7]

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.[8]

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.[13] 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.[11] 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 process

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of cotton spinning, cotton-strippers are exposed to dust arising from cotton husks and débris, which produces a typical form of asthma.

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.

2. *LIVING ORGANIC DUSTS.* These contain particles capable of exhibiting the phenomena of life (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).

Cases of tetanus, reported in connection with jute manufacture, were traced to the raw material, the bacillus having been found in the factory dust. 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.

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 basket-makers, 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.

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. 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.

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.).

II. Inorganic Dusts

Inorganic compounds are of mineral origin, not requiring a living organism to produce them. 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.[1] Lime, calcium oxide, and the di-chromates are examples of irritant dusts. An inorganic dust may possess both toxic and irritant properties, and the combined 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.[4]

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.[23] 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.[24] 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.[25]

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.[14] 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.[14]

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.[14]

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.[1] 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.[5]

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.[21] 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.[22] 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.[22]

The chief distinction between silicosis and conditions due to simple reactions caused by other dusts is the active proliferative

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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.[7]

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.[24]

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[25] 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.[26]

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.[27] 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."[19] 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."[20] 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.[20] 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.[20]

"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."[21]

References

[1] Bloomfield, J. J. and DallaValle, J. M. "The Determination and Control of Industrial Dust." U. S. Public Health Bulletin No. 217, April, 1935.

[2] Collis, Edgar L. "Industrial Pneumoconioses, with special reference to Dust Phthisis." Milroy Lectures, 1915. H.M.S.O., London.

[3] Sollmann, Torald. "A Manual of Pharmacology." W. B. Saunders & Co., Philadelphia. 1932.

[4] Fairhall, Lawrence T. "Toxic Dusts and Fumes." Journal of Industrial Hygiene and Toxicology, November, 1936.

[5] Bloomfield, J. J. "The Sampling and Analysis of Industrial Dusts." American Public Health Association, Yearbook, 1935-36.

[6] Gibbs, W. E. "Dust Hazard in Industry." Ernest Benn, Ltd. London, 1925.

[7] Air Hygiene Foundation of America, Inc. "Silicosis and Allied Disorders." Medical Series, Bulletin No. 1. Pittsburgh, Pa. April 15, 1936.

[8] Kettle, E. H. "The Action of Harmful Dusts." Inst. of Mining and Metallurgy, London, June 14, 1934.

[9] "Dusts, Fumes, and Smokes." Occupation and Health Series, International Labour Office, Geneva. 1930.

[10] Drinker, Philip. "Causation of Pneumoconiosis." Journal of Industrial Hygiene and Toxicology, October, 1935.

[11] "Dyeing." Occupation and Health Series, International Labour Office, Geneva. 1930.

[12] Legge, Sir Thomas. "Industrial Maladies." Oxford University Press, London, 1934.

[13] Burstein, A. "Nicotine Action from Inhaled Tobacco Dust." Journal of Industrial Hygiene, December, 1927.

[14] White, R. Prosser. "The Dermatergoses, or Occupational Affections of the Skin." H. K. Lewis & Co. Ltd., London, 1934.

[15] Schwartz, Louis. "Skin Hazards in American Industry." U. S. Public Health Bulletin No. 215, October, 1934.

[16] Downing, J. G. "Industrial Dermatoses: Treatment and Legal Aspects: Review of Recent Literature." Journal of Industrial Hygiene and Toxicology, July, 1935.

[17] "Occupational Lesions in Workers in Sugar." Belgium Letter, Journal of American Medical Association, Sept. 10, 1927. Abs. Journal of Industrial Hygiene, February, 1928.

[18] "Flour Mills." Occupation and Health Series, International Labour Office, Geneva, 1930.

[19] Mayers, May R. "Susceptibility to Dermatitis." The Industrial Bulletin, Albany, N. Y. Feb. 1937, vol. 16, no. 2.

[20] Drinker, Philip, and Hatch, Theodore. "Industrial Dust." McGraw-Hill Book Company, Inc., New York, 1936.

[21] Schwartz, Louis. "Skin Hazards in American Industry. Part II." U. S. Public Health Bulletin No. 229, Sept. 1936.

[22] "Poisonous Woods." Occupation and Health Series, International Labour Office, Geneva, 1930.

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[22] Hope, E. W., Hanna, W., and Stallybrass, C. O. "Industrial Medicine and Hygiene." Bailliere, Tindall and Cox, London, 1923.

[23] Brown, G. T. "The Diagnosis of Bacterial Allergy." Southern Medical Journal, Vol. 27, No. 10, Oct. 1934.

[24] Sayers, R. R. and Merewether, F. V. "Miliary Lung Disease Due to Unknown Cause. U. S. Public Health Reports, Dec. 5, 1930.

[25] "Actinomycosis." Occupation and Health Series, International Labour Office, Geneva, 1930.

[26] Holland, J. W. "Textbook of Medical Chemistry and Toxicology." W. B. Saunders Company, Philadelphia, 1920.

[27] Bloomfield, J. J. and Blum, Wm. "Health Hazards in Chromium Plating." U. S. Public Health Service Reprint No. 1245, Washington, 1930.

[28] Russell, Jones, Bloomfield, Britten and Thompson. "Lead Poisoning in a Storage Battery Plant." U. S. Public Health Bulletin No. 205, June, 1933.

[29] Neal, Jones, Bloomfield, DallaValle and Edwards. "A Study of Chronic Mercurialism in the Hatters' Fur Cutting Industry." U. S. Public Health Bulletin No. 234, May, 1937.

[30] Sayers, R. R. and Jones, R. R. "Silicosis and Similar Dust Diseases." National Silicosis Conference, Washington, D. C., April 14, 1936.

[31] Sayers, Bloomfield, DallaValle, Jones, Dreessen, Brundage and Britten. "Anthraco-Silicosis among Hard Coal Miners." U. S. Public Health Bulletin No. 221, December, 1935.

[32] Middleton, E. L. "Industrial Pulmonary Disease due to the Inhalation of Dust." The Lancet, July 4 and 11, 1936.

[33] Dreessen, Waldemar C. "Effect of Inhaled Marble Dust as Observed in Vermont Marble Finishers." U. S. Public Health Service Reprint No. 1630.

[34] Lanza, A. J. "Control and Prevention of Silicosis." Symposium on Silicosis. California Tuberculosis Association, San Francisco, 1937.

[35] Newquist, M. N. "Medical Service in Industry and Workmen's Compensation Laws." American College of Surgeons, Chicago, 1934.

[37] "Medical Care of Industrial Workers." National Industrial Conference Board, Inc. New York, 1926.

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 suppression job was engineered [illegible] can be no good. There are many good installations that were never figured at all but grew like Topsy. The [illegible] sulting 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 scientific 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

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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 just 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.

of fumes. Such operations are usually permanent and exposures tend to be more constant, although as a rule the greatest amount of fumes is generated during tapping operations.

Likewise, in the molding processes the molten metal is the source of metal fumes. In welding, cutting, and salvage operations, the metal fumes may originate from metal products processed, coated surfaces of the metals, fluxes used, or from the coating or core of the electrode used.

These latter operations may provide exposure to a greater variety of toxic metals, but as a rule such exposures are to lesser concentrations. Exposure usually is less regular since the operations vary from time to time both as to extent and raw materials used.

Atmospheric Concentrations

Data relative to the minimum concentrations of metal fumes which will produce metal fume fever are limited. It is believed by some that, except in case of the supersensitive individual, metal fume fevers can be avoided by keeping atmospheric concentrations below 10 milligrams per cubic meter of air. Drinker and his associates[4] suggest 15 milligrams per cubic meter as a safe limit where workers are exposed to the fumes of zinc oxide, provided the fumes of such impurities as lead, cadmium, and arsenic are not also present in harmful amounts.

Our knowledge of safe limits from the viewpoint of chronic metal poisoning is likewise meager. Prolonged exposure to lead concentrations in the air breathed should be kept below 1.5 milligrams per 10 cubic meters of air.[5] In the study of chronic mercurialism among fur cutters[6] it was found that cases developed after prolonged exposure to atmospheric concentrations varying from .6 to 7.2 milligrams of mercury per 10 cubic meters of air.

Less than 5 per cent of those exposed to concentrations which did not exceed 2 milligrams per 10 cubic meters of air developed symptoms of chronic mercurialism, and all cases that developed under such exposure were mild. Canavan and his associates[7] reported upon a case of chronic manganese poisoning which developed following exposure to manganese dust, where the concentration in the atmosphere was from 10 to 20 milligrams per cubic meter of air, 9 to 12 per cent of which was manganese.

Metal Fume Fever

A strict interpretation of the term "metal fume fever" does not place it in the class of conditions termed "metal poisoning." The reaction set up in the body is not directly attributable to the toxic metal, or dependent upon the inherent toxicity of the metal particles inhaled. The superficial action of the finely divided metal destroys the tissues, and the absorption of these altered body proteins affects the individual much the same as typhoid inoculation or the injection of other foreign proteins.

Metal fume fever has long been recognized as an industrial disease. Other terms commonly applied to the condition are: "Brass founders' ague," "brass chills," "zinc fever," or "zinc chills," "spelter shakes," etc. Formerly it was thought due to the poisonous effects of zinc and zinc alloys. Various workers in the past quarter century have shown, however, that it may be produced by the fumes of metals other than zinc; notably, copper, magnesium, manganese, and probably lead. Koelsch[8] in 1923 reported upon the occurrence of metal fume fever among employees in a copper rolling mill.

Investigation showed the men to be working under conditions which caused them to breathe air containing heavy concentrations of copper dust. The symptoms resembled "brass founders' ague." In his report he quotes Kissalt[9] as showing that mercury, nickel, and probably other heavy metals when inhaled in vaporized form caused symptoms similar to those of "brass founders' ague."

Drinker and his associates[10] in 1927 reported that men experimentally exposed to fumes of magnesium developed the classical symptoms of metal fume fever.

Clinical Picture of Metal Fume Fever

The clinical manifestations of metal fume fever are as follows: At the end of the day or 2 to 12 hours following exposure to metal fumes, the individual notices a dryness of the throat in addition to the metallic taste which most workers commonly experience during exposure. A feeling of tightness of the chest, varying with the exposure, usually indicates the severity of chills and fever which are to follow. In mild cases the individual may not be aware of any fever and may complain only of a chilly sensation, followed by sweating and general weakness.

Exposure to extreme cold may hasten the onset of fever and chills, but as a rule the worker awakens from sleep with a high temperature and chills, which are quite similar to the chills and fever experienced in attacks of malaria. After they have developed, nothing in the way of extra covers or hot baths appears to affect these chills. Toward the end of the attack the individual sweats profusely and is left with a feeling of marked weakness. In the majority of cases some weakness is still felt the next day. It is commonly believed that hot baths and hot drinks of tea or lemonade may succeed in partially aborting the attacks, if taken at the first sign of respiratory difficulty such as a dry throat or tight sensation in the chest. Drinker and his co-workers[4] by their experimental work were unable to show that even excessive "sweating" of an individual 2 to 4 hours after exposure altered the reactions in any manner.

Examination of the blood of workers suffering from metal fume fever shows a gradual increase in the polymorphonuclear leukocytes which begins toward the end of the attack and persists for some time after the fever has disappeared. This increase in white blood cells appears to have a direct bearing upon the degree of temporary immunity established.

This probably accounts for another characteristic clinical observation. The workers are most likely to be affected after a vacation period. More cases develop after a holiday or on the first day of the week, after an absence of one or two days from exposure. The condition is found more frequently affecting new employees or old employees returning to work after a prolonged absence from exposure.

As a rule, gastrointestinal disturbances are seldom complained of except in cases where exposure has been to fumes of substances affecting the digestive system. For instance, it is well known that zinc coated metals contain other toxic metals as impurities. The welding and cutting of these release the toxic substances together with the fumes from the zinc, as well as fumes from certain fluxes which are used.

We have no conclusive evidence regarding chronic effects produced by repeated exposure to zinc fumes. A study of workers in brass foundries[11] showed that the group experiencing attacks of metal fume fever were in somewhat poorer physical condition than were those who did not develop fever and chills. Theoretically, those experiencing irregular exposures and complaining of repeated attacks of fever and chills which leave them in a generally weakened condition would, in a measure, develop lessened resistance to acute and chronic infection.

Detailed information regarding the pathology of metal fume fever is not available. A search of the literature at hand fails to show any record of death from metal fume fever, uncomplicated. The illness is of such a transitory nature that most of our knowledge regarding blood changes is the result of experimental work and isolated case reports.

In view of the fact that zinc is relatively nontoxic, and of the conclusions expressed by Drinker and Fairhall[12] regarding the hygienic position of zinc, it is difficult to show why chronic illness should result from exposures producing simple metal fume fever. It would seem, however, that in consideration of the recent work showing the role played by zinc in the treatment of diabetes with insulin, possibly some investigation should be made to determine if exposure to metal fumes capable of producing metal fume fever may not affect the endocrine system, especially in persons with some metabolic disturbances, such as potential diabetes or thyroid dysfunction.

Differential Diagnosis

Metal fume fever may sometimes be overlooked, unless the physician considers occupational environment. The condition may simulate attacks of grippe or bronchitis; or, if in a malarial region it may be mistaken for a fresh attack or a relapse from a former attack of malaria. Careful study of the blood will aid in diagnosis; those suffering with grippe or bronchitis seldom show the increase in white cells usually found present in persons suffering from metal fume fever, while those with malaria usually show the organisms present in their blood. The duration of symptoms is usually less in the case of metal fume fever.

However, it is not uncommon to find persistent rales upon examination of the chest several days after an attack. However, in persons with grippe or bronchitis, these rales [illegible] usually associated with a slight elevation [illegible] temperature, which is not found [illegible] persist[illegible] metal fume [illegible], uncomplicated. [illegible]ive exposure producing metal fume fever may be followed by attacks of bronchial pneumonia, as a result of pulmonary irritation and infective organisms commonly present in the respiratory tract.

Metal particles are not the only injurious substance present in fumes generated by some industrial processes. The use of an acetylene torch in a space with poor ventilation has resulted in incomplete combustion of the gas and the liberation of carbon monoxide gas.

Doig and McLaughlin[11] reported upon an illness affecting welders of galvanized metal, using an electric arc. The men complained of lung irritation so severe that their sputum was often blood-tinged. Investigation showed this to be caused by excessive concentrations of nitrous fumes generated by the processes. X-ray examination of the chests of several in this group, who had been employed for many years, showed changes thought due either to the prolonged irritation caused by nitrous fumes, or possibly to the fumes of silica inhaled. The electrodes used were silica-coated.

Chronic Poisoning by Metal Fumes

It is generally recognized that the most serious exposures to toxic metals in industry occur in occupations where the worker breathes air contaminated with these poisonous substances. It is true systemic poisoning by metals may develop in an acute or subacute form, as a result of massive exposure. However, the vast majority of such cases are chronic, caused by frequent and prolonged exposure which leads to an accumulation of the toxic metal in the body. Poisons entering the body by way of the lungs, to be eliminated must be taken up by the blood and lymph. When present in the blood, they are carried to all parts of the body.

Poisons taken in by way of the mouth may ~~not be absorbed~~ but be passed out with the feces. If absorbed, it may be trapped in the liver and returned to the intestinal tract in the bile, and eliminated with the feces. Some, it is true, may be transferred by the blood to distant organs. Most heavy metals and their salts are true protoplasmic poisons. Some, such as iron and zinc, are more common constituents of body tissue. The action of these toxic metals is generally cumulative and no immunity, temporary or permanent, may be established if exposure is to sufficient concentrations.

Because of the fact that metals are usually toxic, the possibility of poisoning from inhaling fumes generated in the processing of any metal should always be given consideration. While zinc itself may be relatively nontoxic, it is seldom used in industry in a form free from toxic substances such as lead, arsenic, selenium, cadmium, and many others.

Following the initial attack of metal fume fever, because of the temporary immunity which they develop, workers may continue under conditions which caused the attack and not suffer a recurrence. It must be borne in mind that these very conditions may afford exposure to other toxic metals which have cumulative effects and later lead to a chronic poisoning. If atmospheric concentrations of the fumes are kept below those capable of producing metal fume fever in the new worker, the chances of chronic poisoning by the toxic metals present as impurities are definitely reduced.

On the other hand, however, these impurities may be present in amounts sufficient to lead to chronic illnesses later, although the concentration of fumes has never produced metal fume fever.

Clinical Picture of Chronic Poisoning by Metal Fumes

The symptoms produced by poisoning from metal fumes will vary. Some metals affect chiefly the nervous system, others the lining of the blood capillaries, while others exert most characteristic injury upon the blood-forming organs.

Generally speaking, the clinical picture of metal fume fever, regardless of the metal responsible, varies only in severity, whiles that of metal poisoning per se varies with the particular metal fume inhaled and with the degree of exposure. For example, massive doses of lead fumes inhaled may produce such acute conditions as lead encephalitis and severe gastrointestinal complications; while continued exposure to smaller concentrations will cause such chronic changes as anemia, lead palsy, and chronic nephritis.

Exposure to heavy concentrations of mercury vapor leads to acute nephritis, salivation, and diarrhea, while the more common industrial exposures to but slight concentrations will eventually produce the typical mercury tremor and psychic changes characteristic of chronic mercurialism. Strictly

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speaking, there are no signs or symptoms of poisoning from metals which can not be due to other causes. For this reason diagnosis is always a matter of differential diagnosis and metal poisoning can only be established by careful consideration of all factors, including occupational history, medical history, clinical and laboratory findings.

While laboratory findings are a very important factor in diagnosis, they can not be relied upon as the sole evidence necessary.

Prevention of Metal Fume Poisoning

While the responsibility of controlling health hazards associated with exposure to fumes of toxic metals rests primarily upon the employer, effective elimination of such hazards can only be secured by the whole-hearted cooperation of employers, employees, the State, and other regulatory inspection agencies. Three fundamentals contribute most to actual prevention. They are: Good housekeeping, supported by engineering control of hazardous processes, and intelligent medical supervision.

Good Housekeeping

We think of good housekeeping as applying to clean floors and work benches; materials, tools, and processes arranged and maintained in good order; adequate lighting, and no overcrowding of work places by men and materials. All these will do much to lessen the concentration of toxic fumes in the atmosphere, but seldom is the control of processes so effective that some fumes do not escape into the general air of the workroom. From here they may be inhaled, or may contaminate the bodies and clothes of the workers. So general workroom ventilation is a factor in good housekeeping.

The provision of adequate washing facilities is a prerequisite. Under certain conditions lockers and showers for workers are necessary for the safe operation of many processes.

As a rule sweeping and cleaning should be done after regular working hours. Not only can a more thorough job be accomplished, but what is more important, other workers will not be subjected to any increase in atmospheric contaminants occasioned by cleaning methods. If vacuum or wet methods are used, accumulated dust is more effectively and safely removed.

Engineering Control

It has been found practical to exhaust, locally, most processes generating metal fumes so that the toxic fume is trapped at its source and does not gain entrance to the workroom atmosphere. This is done by means of hoods or enclosed processes. Special hazardous processes can usually be isolated in the plant, thereby making potential exposure of all employees unnecessary.

Both local exhaust and enclosed methods are more effective if special attention is given to general workroom ventilation. Disposal of fumes trapped by enclosed processes and local exhaust or isolation methods requires that attention be given that such wastes do not contaminate the air drawn into the work places by general ventilation.

Medical Control

Adequate medical supervision entails special care in the placement of workers, and should not be aimed at the selection of only super-men, since it is practical to make work places safe for the average man. Individuals with serious kidney, respiratory, or other systemic diseases should not be placed where they may be exposed even to minimum concentrations of toxic fumes.

Where processes are known to be potentially hazardous, an important check on the efficiency of engineering control is gained through regular periodic examination of workers. By this practice, in many instances, not only will evidence of absorption be detected before serious injury has resulted, but an opportunity is afforded to correct control measures so effectively that the workers showing early signs of absorption may safely continue at their regular jobs. Routine records of illness should be kept.

Any abnormal rate of absenteeism due to illness among an occupational group, regardless of the diagnosis reported, should call for special investigation to determine if there are any environmental conditions aggravating the primary illness.

Personal Protective Equipment

If proper attention is given to the three fundamentals mentioned—good housekeeping, medical and engineering control—only specific and unusual emergency exposure will call for the provision of personal protective equipment.

The masks or respirators provided work

ers who must necessarily be exposed to metal fumes should be of special construction and adapted to the processes and materials used. The United State Bureau of Mines[14] has, after testing, approved certain types of masks for workers exposed to specific metal fumes.

No filter type of respirator capable of protection against toxic metal fumes has been submitted for approval. While two or three filter type respirators have been approved for protection against lead dust, the use of which may in a small way reduce the hazard of fumes, they cannot be relied upon for full protection. Filter type respirators approved for protection against nuisance and pneumoconiosis-producing dusts will not protect the user from toxic fumes.

Several of the hose-line or positive pressure type masks have been approved, but there are certain limitations to their application which make them impractical for use in some kinds of work.

Substitution

In a vast majority of cases, resort to substitution is an impractical method of eliminating health hazards due to metal fumes. The raw materials used usually have special application. Furthermore, substitution is often a dangerous practice, even though it is practical. Instances may be cited where the substituted product has proven equally as dangerous as the one it replaced, the only difference being that less was known at the time concerning its toxic properties.

Bibliography

[1] Experimental Studies on the Effects of Ethyl Gasoline and Its Combustion Products. R. R. Sayers, A. C. Fieldner, W. P. Yant, and B. G. H. Thomas. U. S. Bureau of Mines, Monograph No. 2, 1927.

[2] Quantitative Measurements of the Inhalation, Retention and Exhalation of Dusts and Fumes by Man. I. Concentrations of 50 to 450 mg. per cubic meter. P. Drinker, R. M. Thomson, and Frim, J. L. Jour. Ind. Hyg., Vol. 10, No. 1, Jan. 1928.

[3] Same as 2. II. Concentrations below 50 mg. per cubic meter. Brown, C. E. Jour. Ind. Hyg., Vol. 13, No. 8, Oct. 1931. Studies in Dust Retention. III. Factors involved in the Retention of Inhaled Dusts and Fumes by Man. Jour. Ind. Hyg., Vol. 13, No. 9, Nov. 1931.

[4] Metal Fume Fever. IV. Threshold Doses of Zinc Oxide. Preventive Measures and Chronic Effects of Repeated Exposures. P. Drinker, R. M. Thomson, J. L. Finn. Jour. Ind. Hyg., Vol. 9, No. 8, 1927.

[5] Lead Poisoning in a Storage Battery Plant. Public Health Bulletin No. 205, June, 1933.

[6] A study of Chronic Mercurialism in the Hatters Fur-Cutting Industry. Public Health Bulletin No. 234.

[7] Chronic Manganese Poisoning. Report of a Case with Autopsy Findings. Canavan, M. M., Cobb, S., Drinker, C. K.: Arch. Neurol. and Psychiat., 9:270-1934.

[8] Metal Fume Fever. Koelsch, F. Jour. Ind. Hyg., Vol. 5, p. 87, July, 1923.

[9] Ueber das Giessfieber und verwandte gewerbliche Metalldampfinhalations-krankheiten. Kissalt, K. Ztschr. f. Hyg., 1912, 71, 472.

[10] Metal Fume Fever. III. The Effects of Inhaling Magnesium Oxide Fume. P. Drinker, Thomson, R. M., Finn, J. L. Jour. Ind. Hyg., Vol. 9, No. 9, 1927.

[11] Health Hazards in a Brass Foundry. Public Health Bulletin No. 157.

[12] Zinc in Relation to General and Industrial Hygiene. C. K. Drinker, L. T. Fairhall. Public Health Reports, Vol. 48, No. 32, Aug. 1933.

[13] X-Ray Appearances of the Lungs of Electric Arc Welders. A. T. Doig and A. I. G. McLaughlin. Lancet, April 4, 1936, p. 771.

[14] List of Devices for Respiratory Protection Approved by the U. S. Bureau of Mines. W. P. Yant. Bureau of Mines Information Circular No. 6915.

Electroplating Fumes and Vapors and Their Elimination

By P. B. RASTELLO, M.D.

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The industrial physician is responsible for the health of all employees in his plant, in so far as their health may be affected by their occupations and their environment. Consequently he must be familiar with the various jobs and conditions under which the men work to know definitely the associated health hazards. He must work closely with the safety, maintenance, chemical and purchasing departments to keep himself informed on changes in methods and materials that may influence those hazards.

Thus fortified, the physician occupies a strategic position in the hospital, as the employee invariably comes to him first with complaints which he may associate with his work or which are of a nature that would warrant an investigation which may lead to the discovery of an unhealthy condition.

One of the processes which may be sus-

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Cement and Quarry Sections

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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.

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

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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 e[illegible]all con[illegible]much could be done [illegible]ate the [illegible], the Secretary of L[illegible]ed together [illegible]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 [illegible] degree. Medical examination of [illegible]ally at wo[illegible]ates that between [illegible]d 5,000 wo[illegible] are seriously a[illegible] the disease, in addition to

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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 [illegible] preventing [illegible], 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 [illegible]lation

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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 association 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 [illegible] in quarry operation took place. [illegible] the Wednesday program.

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burgh, 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 air-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 also in the more frequent occurrence of accidents accompanied by an increase in compensation commitments. Some dusts (coal, zinc, 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 intricate 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

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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 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 [illegible] and, if, [illegible] as feasible, the d[illegible] upper holes is reduced to a min[illegible] 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 harmful 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 used 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 materials, 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 haying 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. [illegible] safety requirements [illegible] this hazard have been com[illegible] by being [illegible]

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-ide compensation for industrial disease -bility at a time when new legislation is enacted so rapidly, but most of the im- -ant industrial states now compensate some or all of the conditions which can -ttributed to occupational diseases. Some blanket coverage for all such condi- while others name specific diseases or -cific occupations. There have been in- -tices to both employee and employer, but -h time and increased study of conditions we shall eventually arrive at fairer, more equable adjustments.

The Industrial Nurse finds herself today in this arena of changing policies and evolutionary social adjustment. It is her privilege to be one of the connecting links between employee and employer. If she is the type that commands the respect and trust of the men and realizes her responsibility to them, she will likewise be most valuable to her employer.

The Nurse's Part in the Sickness Prevention Program

By PHOEBE BROWN, R.N.

Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

The extent to which the nurse enters into the sickness prevention program depends upon the type of industrial medical service maintained.

Some industrial plants maintain a nurse primarily for their Employees' Benefit Association, and thus her work is chiefly that of welfare. She administers not only to the members, but to their families as well. What a fine opportunity she has to influence such employees and their families to a keener understanding of good health and better living. For after all, the problem of sickness prevention concerns not only the individual employee, but also his family.

To fill her place successfully in such a program the nurse must recognize one basic principle—*she must be a humanitarian*, and regardless of the problem confronting her she must give relief through aid or counsel, whichever the case may be. She must have knowledge of the personnel she serves, their modes of living, their idiosyncrasies, their families and environments. By keeping her ear to the ground constantly she learns of their problems so that she may then solve them.

Naturally a knowledge of the community served is vital, for often through constructive criticism she is able to elevate the health standards through better sanitation and civic pride.

Perhaps a better conception of the sickness prevention program in connection with welfare work may be had by actual case analysis:

Not long ago I was called to the home of an employee who had been reported sick at frequent intervals during the past two years. He was underweight, nervous, and irritable. On my first visit he was confined to bed and vomiting excessively. His wife informed me that he had attacks of this type periodically. He would not have a doctor, because his doctor did nothing for him except give him a prescription that cost too much and tell him to be careful what he ate.

While in the attack he was careful enough, for he ate nothing for two or three days; but as soon as the illness was over he went back to his old diet of meat, potatoes, plenty of spices and relishes, copious amounts of coffee, two packages of cigarettes a day, plus a goodly amount of beer each week-end.

At one time the doctor had said he should have an X-ray of the stomach, but he complained that this would cost him $40 which he couldn't afford, and anyway he couldn't get away from work when he wasn't sick.

I finally made him realize that he was losing much more time and money being ill every two or three months, losing four or five days at a time, than if he were to find out just what did ail him and then do something about it.

I took him to a clinic which was conducted on a part-payment basis, and complete examination was made with X-rays and blood work. After he was convinced of the necessity of a proper diet, his attacks became less frequent, he gained weight and was a much pleasanter fellow at work.

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In another instance an employee's wife had undergone an operation at a local hospital. Visiting her later at home, I learned that she was recovering satisfactorily but that there were desperate financial troubles. The husband earned 92 dollars a month. There were seven boys in the family, the oldest 18 and unemployed. Questioning the children, I discovered that one, aged 12, was graduating from school but did not even have a graduation suit. His father couldn't afford it because he was paying $5 weekly on his wife's $90 hospital bill. He was taking care of the doctor's bill by doing some repairing and cleaning in his office.

After discussing the problem with the employee, I visited the hospital authorities. Hearing the story and realizing the effort the man was making, the hospital gladly discounted $50 from the bill. Payment of the remaining $30 was made by the Employees' Welfare Loan Fund, and this is turn was deducted from the employee's pay check at the rate of $2 a week. The total cost to the Welfare Association was slight, but the assistance and feeling of security given this employee was immeasurable.

But let us leave this type of program and turn to the industrial nurse who serves chiefly in a first-aid department and very seldom contacts the family or the home of the employee. How does she best serve in a sickness prevention program?

Here, again, her knowledge of the personnel is indispensable. She should review the personal record of the employee with the employment manager to obtain a better understanding of the individual. This should be followed by a study of the employee's job; where he works and under what conditions, especially sanitation; the product manufactured and the raw materials it is made of. There the nurse may obtain valuable information as to latent hazards that eventually may affect the health of the employee, oftentimes recognized too late to cure effectively.

From this and a study of past sickness she maps her program of prevention as follows:

1. By suggesting better working conditions, such as improved illumination, sanitation, housekeeping, ventilation, and use of proper and adequate protective equipment.

2. Education of the employee to higher health standards. This requires constant attention through bulletin boards, mass meetings, news items and personal contacts.

3. By advising and assisting the employee in securing correction of physical defects and social maladjustment.

The following case is an example:

An employee had repeated attacks of rheumatism and had been advised by the family physician to have his teeth extracted, but he did not know where he would get the necessary dental fee.

We had introduced a plan whereby our employees were allowed dental services, in special cases, through the Welfare Association. If an employee were a reliable workman and had been with us for more than six months, we had an opportunity to investigate his financial condition. If he were honest but having a difficult time establishing his credit, he was given an order to one of three dentists whom we were assured were giving our employees fine dental care at a minimum charge. The dentists were glad to render this service, for they were not only sure of their accounts but were also increasing their practice by developing new contacts. This employee as well as many others profited by the plan.

The following are only a few examples of a nurse's function in an industrial health program:

A sudden increase in the number of athlete's foot cases indicated that someone was a carrier and was spreading the germs in the shower rooms. A suggestion to the sweeper brought the condition under control when proper spray and foot baths were installed.

The use of corners by employees as a place to expectorate was effectively solved by painting white triangular areas in the corners and providing cuspidors containing a disinfectant, thus reducing the spread of diseases from respiratory infections.

In another instance three employees from the same department made regular trips to the first-aid station for aspirins each week. Reviewing their personal record cards indicated normal health and habits. A trip to the department revealed inadequate and glaring lights. A proper survey not only corrected the condition from a physical standpoint but likewise increased production to such an extent that a similar survey was made throughout the plant.

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A high frequency of indigestion, nausea and fatigue is often traceable to improper ventilation, suggesting proper air-conditioning or protective equipment to eliminate this hazard.

It is quite true that such a program presents a real problem in selling the idea of sickness prevention to executives—but patience and frequent reference to the time lost through sickness will eventually bring results.

I wish to quote a few paragraphs from the reports of disabling illness among industrial employees in 1936 as compared with earlier years. This report was released by the Division of Industrial Hygiene of the National Institute of Health and compiled by Dean K. Brundage.

Respiratory Diseases

The respiratory group of diseases accounted for most of the increase in the incidence of illness in 1936. With the exception of tuberculosis of the respiratory system and diseases of the pharynx and tonsils, each respiratory disease sub-group occurred at a higher incidence rate in 1936 than in 1934 or 1935.

The frequency of influenza and grippe in 1936 (15.1 cases per 1,000 men), was 19 per cent higher than the rate for 1935 (12.7 cases per 1,000 men) and 50 per cent greater than for 1934 (10.1 cases per 1,000 men). Nevertheless, the rate for 1936 was 4 per cent below the average rate (15.8) in the preceding five-year period."

"Another development of an unfavorable nature was an increase in the number of cases of bronchitis, acute and chronic. In 1936 this disease occurred at a rate of 4.8 cases per 1,000 men which was 41 per cent above its average incidence during the years 1931-1935. The incidence of diseases of the pharynx and tonsils in 1936, although 4 per cent higher than in the preceding five-year period, was below the rate for 1935. The rate for pneumonia (all forms) in 1936 (2.6 cases per 1,000 men) was 13 per cent above the rate for 1935 (2.3 cases per 1,000 men), and in turn exceeded the rate for any year since 1929. Among the industrial policyholders of the Metropolitan Life Insurance Company, the *death* rate from this disease in 1936 as compared with 1935 increased 5 per cent."

"Other diseases of the respiratory system, including diseases of the upper respiratory tract, showed a sizeable increase in frequency in 1936 as compared with all the former years. Most noteworthy in the record since 1921 is the *downward trend* in the new cases of *tuberculosis of the respiratory system*. The incidence has decreased from 1.9 cases per 1,000 in 1921 and 1922 to .8 cases in 1936."

This is an excellent indication of the effectiveness of educating the child and the adult.

"Rheumatism, acute and chronic, which showed definite improvement in 1934 and 1935 (4.0 cases per 1,000 men) as compared with earlier years increased to 4.2 cases per 1,000 in 1936. This rate was below the five-year average. Diseases of the organs of locomotion, except diseases of the joints, occurred at a rate of 3.2 cases per 1,000 men in 1936, which exceeded the rates for 1933, 1934, and 1935, as well as the average for 1931-1935."

How frequently and to what extent sickness among employees is a factor in causing lost time accidents is often revealed when a thorough investigation is made of all incidents leading up to the accident; such facts properly presented enable one to improve plant conditions for better health.

A good share of the sickness prevention program is education. Few employees, for example, realize that they have more leisure time than they have ever had before. The employee should be taught to use this with discretion. Today we practically have a national 40-hour work week, and allowing at least 56 hours for sleep, we find the employee has 72 hours left out of every week to use as he wishes.

Does he spend his idle time disastrously, thus adding fatigue to an already fatigued body? To safeguard against this you may find it worthwhile to afford him recreational facilities, stimulating in him a desire for hobbies, home ownership, or any other activities that may enable him to spend his time more profitably.

Plan a definite program of Better Health talks during the winter months.

The National Safety Council and leading insurance companies can provide excellent material for these discussions. Your state and national health departments are glad to furnish valuable information free of charge.

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

General Chairman—
Vice-Chairman (In
N. J., Marine Dep
Vice-Chairman (In
New York, N. Y
Vice-Chairman (Fo
Wilmington, Cali.
Secretary—CARL F.
News Letter Edito
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Engineering Comm
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Membership Comm
York, N. Y.
Program Committee
Francisco, Calif.
Statistics Committee
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Francisco, Calif.
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F. KAVANAGH,
FRANK C. LAURIE,
E. LUCKENBACH
JOHN MCGRATH, J
E. PETERSEN
W. PROOM, 1 B
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Wood Products Section

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LOUIS W. KERBERG, Mengel Body Co., Louisville, Ky.
J. A. PURDY, Michigan Mutual Liability Co., Detroit, Mich.

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LOUIS W. KERBERG, Mengel Body Co., Louisville, Ky.
J. A. PURDY, Michigan Mutual Liability Co., Detroit, Mich.
HARRY J. KELLEY, American Seating Co., Grand Rapids, Mich.

MONDAY AFTERNOON SESSION

October 11, 1937

The session was called to order by General Chairman Harry J. Kelley, American Seating Co., Grand Rapids, Mich., who introduced the speakers.

Combating the Dust Problem in the Wood Products Industry

By J. G. SISSMAN

Director of Research, Surty Manufacturing Company, Inc., Chicago, Ill.

The best protection against fire in wood working plants is dust control cleanliness, which means keeping the air dust-free, preventing the accumulation of litter on floors, benches, and tools, and guarding against the accumulation of dust on oily moving parts where friction will readily raise the temperature to the burning point. An adequate dust collecting system is the best protection against wood-shop fires.

Remember, a dust collecting system itself must be designed with this fact in mind; fire as well as air and dust can be carried through air ducts.

The fire hazards in wood plants are well known. A study of such hazards, made by the National Fire Protective Association which published a report in 1932, gives a full analysis of some 1,700 fires in woodworking plants and shows the proportion of danger in different parts of the plant and the ratio of fires of dust origin in comparison with others.

The explosion hazard also has been carefully surveyed. It is present when dust is sufficient for combustion to be instantaneous over a considerable area. Explosion hazards, like fire hazards are best controlled by ventilation which precludes the accumulation of dangerous dust in plant atmosphere.

Fire danger is present in wood working operations whether performed in open sheds or totally enclosed buildings. Explosion hazard is increased with enclosure of the process in closed buildings. Bulletins 562 and 617 U. S. Department of Labor, Bureau of Labor Statistics, and several pamphlets of the National Safety Council contain complete safety information for prevention of dust explosions. They sum up the collected, classified knowledge in this field and point out the close linkage between fire hazard and explosion hazard and show that either may be the cause of or the consequence of the other. These bulletins in conjunction with the rules or laws effective in your own state for removal of dust and gases, will enable you to work out a campaign against the hazard of dust explosion.

The nuisance problem in woodworking plants also requires dust control. Nuisance problems fall into several groups. Dust may impair the value of the product by marring its finish. Furniture factories and cabinet makers suffer most from this nuisance. Dust may cause accidents by making the footing uncertain, by hiding obstructions on or defects in floors or the exact location of knives and cutting edges. Dust of any kind in the eyes is a nuisance and a dangerous nuisance. Nuisance dust, like fire hazard dust and explosive dust is adequately and satisfactorily controlled by ventilation.

Wood working dusts, with the possible exception of a relatively small amount of abrasive material which they contain, are bulky. There must be continuous removal of wastes of manufacture to leave room for men, machines and work in the plant. For many years this was the only aspect of the case considered. Broom and shovel methods, which once were standard in the wood working trade for removal of wastes, were sufficient and would still be sufficient, but the presence of other hazards of wood dusts complicate the problem. Broom and shovel methods are no longer acceptable. Moving air is the one effective means of disposal of wood wastes because it does so in a satisfactory manner and because it fits into the scheme for guarding against other hazards.

The material so collected is frequently usable either as fuel within the plant or is salvagable and saleable which helps reduce substantially the cost of safeguarding the plant. This is the only phase of the dust control problem which shows a direct profit. The others are an immediate charge on the industry which must be met as part of general overhead. They show their profit indirectly in the prevention of injuries to men and the saving of the cost of injury to industry.

The last of the quintette, according to my classification, is wood dust as a health hazard. This quint has several characteristics: effect of wood dust on the human system; effect of abrasive dusts on the human system; effect of dust or materials other than wood or abrasive used in place of wood or in combination with it on the human system; effect of dust resulting from the finishing operation on the human system.

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Products Industry

ny, Inc., Chicago, Ill.

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Wood dust is not dangerous in the sense of silica or lead dust; but wood dust is not innocuous. Any dust inhaled in sufficient quantities is detrimental to health and wood dust is not excepted.

The industrial bulletin of the state of New York for July, 1936, contains an article by Adelaide Ross Smith in which the relationship between wood dust and respiratory disease is set forth. Dr. Smith points out that wood working is a dusty trade and while the dusts are not primarily siliceous, more respiratory disease is found in the wood working plants than in plants where dusts are not present. She suggests that perhaps more silica dust is present than is suspected. Studies to determine which of the dusts present in woodworking are dangerous have not been made, at least not with sufficient detail over a long enough period of time. But statistical evidence definitely places wood working in that class of industry in which there is some exposure to silicosis, as shown by the high mortality from pulmonary tuberculosis.

In the study made by Oliver, in which the death rate of the agriculturist from diseases of the respiratory system was taken as a standard or 100, the rate for potters was 150; stone quarriers 261; cotton workers 244; wood workers 238; masons 215; wood manufacturers 202; and bakers 177. If this figure is a true picture of deaths in the wood working trades due to respiratory diseases, 238 as compared with 100 as the standard, it is obvious that wood dusts are definitely detrimental to health.

Reports from the Registrar General of England and Wales, show the same general situation. Under the English system wood workers are rated at 103 per cent, compared with agricultural workers who are rated at 59 per cent. Woodworkers rate 339 compared with the general population rate of 180. In the case of cabinet makers the rate is higher, perhaps because more dusts other than wood dusts are present in the atmosphere they breathe. One hundred and seventy-eight trades are listed in this report, rated from 1 to 178. Under the heading "respiratory tuberculosis" cabinet makers rate 117, other wood workers 81. Under "bronchitis" cabinet makers rank 121, other wood workers 64. Under "pneumonia" cabinet makers 51, other wood workers 28. Excepting under the heading of "pneumonia," cabinet makers do not rank well. Other wood workers seem to occupy a middle place.

Dust in wood working trades is therefore a definite hazard to the health of workers and of particular significance in the impetus which it gives to diseases of the respiratory system.

Of less actual significance, but of considerable interest because it is seldom considered as a hazard to wood workers, is contact with woods or wood dusts which are poisonous. Bulletin 616 issued by the U. S. Bureau of Labor Statistics, also the Handbook of Labor Statistics, 1936 edition, contain two interesting references to poisonous woods. The first of these, which appears on page 350, refers to an outbreak of dermatitis in a wood working plant employing 100 men. As a result of contact with Brazilian walnut wood dusts, 11 cases, a rate of about 10 per cent developed dermatitis of varying severity which, in some cases, incapacitated the man for several weeks. The inference was that a large measure of tolerance of toxins in that particular wood can be developed.

An extensive account appears on page 354 of the same bulletin. It is a reprint of a bulletin issued by the International Union of Wood Workers for September-October, 1931. This bulletin states that there are many woods, particularly those grown in the tropics, which contain active poisons.

The actual number of cases reported is relatively small. This is due to the slow action of the dust and the fact that many physicians are not familiar with occupational exposure or the resulting disabilities, and so do not associate the illness with patients' trades.

The most frequent symptom of wood poison is dermatitis which may be slight or severe. Other effects may be palpitation of the heart, shortening of breath, or dizziness. Such symptoms also come from inhaled dust. Repeated contacts do not confer a tolerance of these poisons; in fact they may make one super-sensitive, so that working on ordinarily harmless woods causes a re-occurence of incapacity. The toxic substance occurs as volatile oils or alkaloids. Quite a number of woods are enumerated.

It is the good fortune of the wood working trade to be able largely to stand aside from the most serious dust [illegible] the problem of silica dust, since so far there is little [illegible]

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show that silica is a substantial danger in the wood working field. This is true despite the reference to the report of Dr. Smith. While that danger is slight at present, it is a growing danger, due to the use of extremely high speed sanding devices for finishing operations, using siliceous material as abrasives, and to the growing use of products of non-wood origin in the woodworking shops. Many of the panels now being worked in wood shops contain high proportions of asbestos and other silicious minerals. Where this is done, the worker may be exposed to concentrations of silica dust sufficient to present a definite hazard. It is well to make occasional survey of your plant to determine exposure continuous or intermittent.

While perhaps finishing operations are not properly a part of the woodworking operation they do occur in so many plants that their existence should be pointed out. Changes in the stains, paints or other finishing coatings causing lead poisoning lessen that hazard compared to 20 or 25 years ago. The nitrocellulous and pyroxylin finishes which are displacing paints, are distinctly dangerous. Volatile materials comprise about three-fourths of the mass, which is then thinned by the addition of other volatiles to several times the original volume. They are dangerous. In addition to health hazard, these finishes add to the fire and explosion hazard of the wood working plant. Acetone and acetates, ethylenes and alcohols are the principal toxics which enter the new finishes. Descriptions of these ingredients will be found on page 337 of Bulletin 116 previously mentioned.

It appears that, from the point of view of health hazards, these conclusions can be drawn: (1) Wood dust is dangerous to health and increases the incidence of respiratory disease. (2) Dermatitis is a result of contact with woods of tropical origin and their dusts, and will follow exposure. (3) Silicious materials are a factor in the high incidence of pulmonary diseases in the wood working plants. (4) New materials, particularly those having appreciable silica content, present new dangers which must be carefully guarded against. (5) The new surface finishes, to a large extent replacing the lead pigment paints, obviate one danger and introduce new dangers of their own.

Dust then presents five different problems to the wood working trade. A good ventilating system will solve all five problems, reducing dangers in four instances, and in the fifth reducing direct costs.

Good Housekeeping in Woodworking Plants

By JAMES C. WILSON

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Good housekeeping is and always has been one of the most important features of a successful manufacturing program. Fundamentally it is the outstanding feature if considered in its broadest terms. It includes not only a sensible, intelligent handling of sales, accounting methods, packaging and shipping, but, more specifically, production methods and the habits of the men engaged in production.

It seems obvious to us that when a new plant is being designed or when an old one is being rebuilt, the plans should include and provide for good housekeeping through the following details:

A complete and efficient dust collecting system is a basic necessity, and once installed it must be serviced constantly to retain its efficiency. The removal of all waste material from floors and around machines is a full-time job requiring definite assignment to a clean-up crew.

In laying out the machine setup, good housekeeping requires an intelligent plan under which the machines are grouped so that the progress of stock being processed is such that there is a continuous flow towards completion with no back-tracking.

In many of the older plants, the output has changed and new machines have bee

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