Occupational Diseases

FRIDAY MORNING SESSION

October 9, 1936

The session was called to order by the chairman, Dr. Hart E. Fisher, Vice-President for Health, National Safety Council, and Chief Surgeon, Chicago Rapid Transit Co., Chicago, who presided, introducing the speakers.

The Lesser Known Facts About Common Occupational Diseases

By DR. ROBERT B. HUNT

Medical Advisor, American Mutual Liability Insurance Co., Boston

Probably the leader in the parade of industrial diseases is an acute or chronic inflammation of the skin which we call dermatitis. This disease may present itself in any type of shop, factory or foundry. Any paste, powder, gas or liquid which comes in contact with the employee's skin, even the water supplied by the town in which he lives or works, may be the potential cause of such a skin disturbance.

The wide diversity of causes together with the varying susceptibility of different individuals makes the problem of control difficult.

Much investigation is under way to determine why one person may be susceptible to a certain substance while another is not. It has been proved many times that a poisonous substance formed within the body has been able to prolong the action started by some external influence. A printer developed a marked dermatitis from ink which persisted for two years. Finally food tests were made and showed that he was susceptible to lettuce, which, when removed from his diet cleared the skin. He returned to his usual occupation without a return of symptoms.

The poisoning of allergic substances is usually an accumulative process. It takes time to produce a manifestation of disease, but let any other substance cause the disease, and the irritating food may be of sufficient strength to magnify its action.

All cases of dermatitis cannot be cured by eliminating offending foods, but further investigation along these lines may give us a clue with which to lessen the loss of time from work and the discomfort now produced by industrial dermatitis.

Metals

Lead

The distribution of lead poisoning is quite extensive.

The skin of the body is a protective covering, and as long as it remains intact it does a good job except in the case of tetraethyl lead, which is used in blending gasoline and which is readily absorbed through the skin, having a tendency to create changes in the nervous system. The effect of other forms of lead, through that avenue of entrance, is practically nil, which explains the extremely low poisoning rate in typesetters, painters and others who continually come in contact with metallic lead.

Lead in any form, introduced through the mouth, acts rather slowly when compared with the inhalation of lead dust or fumes. However, no matter what the portal of entry may be, lead is acted upon by the body fluids and so converted that it may eventually be deposited within the bones.

Those bony safe deposit vaults may retain their lead contents for days or for years, and if the exposure is removed, may also free the employee of all signs and symptoms of lead poisoning. But imagine the surprise of that supposedly cured person when years later, perhaps following some type of infectious disease or the excessive use of alcoholic beverages, he awakes to find that he suffers the aches and pains and paralyses of an acute lead poisoning. As the body fluids alter lead that it may be deposited, so may those fluids attempt to de-lead the body, and too rapid absorption may produce the original disease with all its discomforts.

One can readily see, then, that in some cases investigation of previous occupations is quite necessary to determine the original contact with lead.

Heating of molten lead causes a black scum of lead suboxide to form on its surface, and the heat from the metal disburses the fine powder into the air. Hence, in the process of smelting ores such as zinc, copper and silver, mixed with lead, we find a rather high lead poisoning rate.

Those engaged in the manufacture of lead wire and cables, batteries, glass, pottery and rubber industries, plumbers and users of dry colors offer their share of lead poisoning.

Probably the greatest source of lead poisoning may be found among those who sandpaper, scrape, chip or burn lead paint, for the dust and fumes caused by those activities are rather rapid in their action. Such workers may become incapacitated in a few days because the inhalation of lead dust causes the maximum amount of absorption into the blood stream in the minimum space of time.

Chromium

Chromium is a metal widely used as a foundation for colors, and dusts from its various salts may produce lesions of the skin and mucous membranes of the nose. Chromium plating by electrolysis may cause fumes which are similarly irritating. Although chromium poisoning does not usually cause death, the number of days of absence from work on account of incapacity which it causes is gradually increasing.

Other Metals

The most efficient portals of entry of foreign substances into the body are the nose and mouth. The smaller the dust (the size of smoke particles for example) the greater the speed of absorption by the blood. Fumes from hot metals carry not only poisons but numerous minute dust particles. This explains the incapacities occurring among those engaged in acetylene and electric cutting and welding. When men are so employed over a prolonged period of time, the constant inhalation of fumes and dust might produce symptoms of the metal upon which they work. In the shipbuilding trade, particularly in the construction of metal ships, we find occasional cases of metal-fume fever. "Brass chills" and "spelter shakes" from zinc are names applied by the lay people to such diseases. The terrific heat applied to some of our common metals and alloys by acetylene torches produces sufficient fumes to cause a temporary incapacity in 24 hours. Permanent disability from such causes is rare, however.

Diseases Due to Dust

Twenty-five per cent of all workers exposed to high concentrations of inorganic dust are expected to develop changes within their lungs due to that agency. We are at a loss to explain why the other seventy-five per cent are not so affected.

Mining, quarrying, foundry work, grinding, sandblasting, abrasive soap manufacturing, asbestos work, the making of emery and carborundum products and many other occupations offer opportunities for employees to inhale microscopic dust particles and create a foundation for possible future incapacity.

We are interested particularly in those men who work with sandstone, quartz, flint, granite, and sand, because they expose themselves to silica, and the chemical changes between that dust and the body fluids, in the presence of tuberculosis, may and usually do lead to a fatal ending.

It is safe to say, in light of our present knowledge, that the action of other inorganic dusts is much less virulent and incapacitating. That, however, does not allow us to lower the vigilant methods to improve dust control and protect employees, because all dusty occupations are potential trouble makers.

Although the actions of various dusts differ within the body, the exposure to asbestos fibres, present in the weaving and grinding of dry asbestos material, offers another type of dust which may cause fatalities among workers.

The organic dusts from cotton, silk, wool, tobacco, flour and similar substances are practically harmless. Such dusts rarely reach the lungs but may cause irritation of the windpipe and larger air tubes and result at the most in a mild bronchitis.

The factor which should be borne in mind, particularly when dealing with silicosis and asbestosis, relates to the progression of such disease. When changes occur within the lungs as a result of the presence of such dusts, nature forms scar tissue to heal such lesions but may fail to stop when the job is finished. As a result, the continuation of that healing process may lead to such structural changes within the lungs that partial or total incapacity may follow months or years after the employee has been removed from his dusty occupation.

Benzole-Benzene

Benzol is a distillate of coal tar used extensively in industry. It is an essential ingredient in the manufacture of explosives. It is an excellent solvent for grease, oils and cements, and because of that property it is important in many phases of the rubber and cleaning industries. In the manufacture of shoes benzol may be an ingredient of the dressing applied to the leather and of the cement which fastens the heels and soles. Not only in the shoe trade but in other branches of industry where employees work with gummy, sticky material, the workers soon learn of the solvent and cleansing action of this liquid and use it freely for that purpose upon themselves. The subsequent outbreak of skin afflictions may be the first indication of such unauthorized use.

Benzol is extremely poisonous, entering either through the nose or mouth or absorbed through the skin. Its action within the body is varied and may produce a multitude of signs and symptoms. The bone marrow becomes affected which in turn alters the character of the blood; hemorrhages are common; it may cause death.

The fumes from benzol are heavier than air and lie near the floor, which is an important point in the engineering problem of ventilation.

The members of the benzene group are absorbed through the skin, and more cases of poisoning are found when men perspire than when their bodies are cool. Probably the answer to that is that the fumes may solidify as they cool and the powder may settle on the skin. The sweat on the body may dissolve this dust so that it is more readily absorbed through the increased surface blood supply.

Chlorinated Hydrocarbons

This group of petroleum derivatives has been known to science for years but during the past decade its advance into the industrial field has been widely distributed and most important. Led by carbon tetrachloride and its chemically associated members, it has furnished industry with refrigerants for ice chests, excellent solvents for rubber, wax, oil and grease, thinners for lacquers and a very fine household necessity for the removal of spots from clothes. Hospitals have been using it more and more for the removal of adhesive plaster.

Due to the non-flammability of carbon tetrachloride, it is used in fire extinguishers. The rapid evaporation produces fumes which may smother a small blaze, but we must not forget that excessive heat of the actual fire may bring about combustion sufficient to produce such biproducts as hydrochloric acid and phosgene gas. Like its associated member, chloroform, it may produce sleep when inhaled by an individual, and only 1/350 of an ounce in a quart of air is necessary to produce such action. That thought must be remembered when a large quantity of those liquid products is spilled on the floor, perhaps accidentally. Action should be started at once before the liquid gasifies, and employees should be notified to keep their heads up to avoid the low ceiling of gas.

Chemists have developed and introduced to industry many new products, the basis of which is the chlorinated hydrocarbons. These derivatives of petroleum distillation are frequently combined with those from coal tar to form valuable chemical combinations. They have been placed on the market so rapidly that medical science has been unable to determine their physiological effect upon the health of man. We have known that some of these chemicals are capable of creating changes in the liver, and only recently in a city in Massachusetts one of these newer products caused the death of two employees and a battle to retain life among two others.

Carbon Monoxide

You remember the adage, "Where there is smoke, there is fire." We might add to that, "Where there is fire there is carbon monoxide."

This odorless but poisonous gas may occur in any industry or in any home, but the poorer the ventilation the better the chance of producing physical incapacity.

Since the advent of the motor car, whose exhaust pipe may pour forth as high as 6% of carbon monoxide, we are all exposed to that gas, particularly in crowded cities. The ordinary passenger car liberates about two cubic feet per minute, and one can readily estimate the physical damage that may be done if such a motor is allowed to run within the doors of a poorly ventilated garage or shop. Fortunately, serious cases of such poisoning are not common among those employed in public garages, but many of those employees are likely to complain of headache and faintness at the end of a day's work, especially in colder weather when doors and windows remain closed.

In the steel industry, where gas is used as the heating agency in the blast furnaces, care must be used to provide proper ventilation. Within the mines, workers are warned to allow enough time following blasts for the escape of this gas.

Being a colorless, odorless and tasteless gas, quick of action within the human body, the manifestation of the very first symptom may be too late to save a workman from partial or total incapacity or perhaps death.

Because the exposed person suffers first from motor paralysis, he may be unable to help himself or even to warn others of the danger. Even if removed from the poisonous gas at that period, the damage actually done by the gas may result in permanent physical damage.

Infection

The skin is a protective covering of the body against infection and is extremely efficient as long as it remains intact, but allow it to be broken or punctured, introduce bacteria, and a battle ensues between the offensive agencies of infection and the defensive powers of the body. The winning of such a struggle may determine the presence or absence of incapacity. Infections are common throughout industry, but two types are particularly prominent—infection resulting from anthrax and infection among meat packers and fishermen.

Many of our fur, hair or wool-covered animals may contract anthrax. The germs of that disease defy the ordinary methods of sterilization and may linger on hides, bristles or hairs for long periods of time. Tanners, wool sorters, and hair or bristle workers may introduce the anthrax spore beneath their skin and undergo much physical suffering and sometimes death.

Infections are frequently found among meat and fish packers and those engaged in deep sea fishing. Although death rarely occurs, the loss of fingers, hands and nasty septic wounds are the result.

Punctured wounds, cuts, abrasions, burns and scratches are potential avenues of entrance for bacteria which would seem to be waiting everywhere at all times for such a break in the skin. Early medical treatment might often save later surgical interference, not to mention the accompanying discomfort, incapacity and perhaps the loss of an essential body part.

Summary

I feel that the time has come when an employer must demand of a manufacturer the answers to two questions:

1. How will your product affect my business?

2. How will your product affect the health of my employees?

That employer is entitled to honest answers based upon sufficient chemical and physiological examinations of the questionable product. That manufacturer should be held responsible for the ills produced by the use of his product and unless he can guarantee its safety, it has no place in industry. Too many lives have been lost or jeopardized by too little knowledge of a product's action upon those who handle it.

The incidence of lost time due to illness and injury in industry has been greatly lessened by the many agencies working along lines of safety. When industry has been made fool-proof by the substitution of non-toxic preparations for those now found to be harmful, and when each employee is imbued with the idea that constant thoughtfulness and care are most necessary for the maintenance of health and happiness, then, and not until that idealistic stage has been reached may vigilance and perseverance to maintain and preserve health, limb and life be lessened.

Pre-Employment Examination as an Aid to the Control of Industrial Diseases

By DR. W. C. TEMPLER
Medical Director, Corning Glass Works, Corning, N. Y.

We may well ask whether or not physical examination is of any value to the world at large, rather than limit the discussion to the control of industrial diseases. In the conservation of life and health much progress has been made in the eradication or control of such diseases as occur in epidemic form, as well as that type of disease which is not truly epidemic, but occurs in such frequency that general health programs are necessary. Much has been done to control such disabling illnesses as heart disease, arterio-sclerosis, kidney disease and diabetes; and something has been accomplished in the control of morbidity, which tends to, at least, make people happier through good health, even though an increased span of life is not gained.

Physical examination has played a large role in accomplishing these things, because it was through physical examination and physical observations that investigators were led to exert themselves to find a remedy for the cause of such conditions. Small-pox is no longer prevalent, due to such observations, which led to its control by vaccination. Malaria and yellow fever have been brought largely under control, and knowledge is now available in the control of venereal diseases, if the proper physical examination and laboratory methods are used to arrive at a diagnosis. We are all familiar with the results obtained in decreasing the death rate due to tuberculosis. In fact, in the treatment of all epidemic-type diseases that have so far been eradicated, the examination of patients to determine the severity of symptoms and the improvement has been of foremost value.

Knowing that the average span of life has been increased eight years in the last quarter century and assuming that the above mentioned factors have had some bearing on it, could we decry the value of physical examinations for the general population?

If we know that examinations made by insurance companies and their associating examining institutions, the clinics run by the United States Public Health Service, and the great mass of physicians, who all carefully examine their clientele, have been of value in the control of disease, may we not assume that examinations in industry will help control the incidence and extent of industrial disease, particularly when the life expectancy of industrial workers is less than that of the general population?

In fact on April 14, 1936, at the National Conference on Silicosis and Similar Dust Diseases, called by the Secretary of Labor, Dr. R. R. Sayers of the United States Public Health Service said; "Preliminary and periodic physical and roentgenological examination should be made of all employees engaged in industrial processes where there is a potential if not actual exposure to excessive concentrations of silica in the atmosphere."

Naturally in the early work of industry, only basic materials were used, ingredients had not arrived at a state of development and complexity, when intricate chemical compounds and other toxic materials were even known of, much less used. At the present time over 500 materials are listed which can, under certain conditions, cause industrial disease and the list is by no means complete, inasmuch as experimental work is being done by the personnel of practically every plant or industry to improve or enlarge its manufactured products by taking advantage of the great amount of knowledge science has given us.

Industrial examinations are of two kinds. First, the pre-employment examination, which consists of a very careful history, not only of the family, but also of the previous occupations with length of service in each, previous health and illnesses and present habits. Naturally such a history is of no value unless truthfully given and a reasonable amount of time must be taken to acquire details, which are often vague in a workman's mind or considered by him to be unimportant. The physical examination, of course, varies with the type of industry, and should be given with the knowledge of what the man's exact occupation is to be, and by a physician familiar with the industrial processes in which he is to be employed. In this way selected employment can be obtained for men who have some basic disqualification for one job, but which does not impair their ability for useful employment and the conserving of health in another.

The physical examination must be thorough. It should include all methods of determining a latent disability or one that is already present. Many examination forms are available from insurance companies or other health services, which have been designed entirely for industrial work. It has been the experience of men interested in this work, that all the special senses of the body must be tested as well as the measurement of motion in all joints. The cardio-vascular system is of great importance as is the respiratory and gastro-intestinal tract.

Re-examination and periodical checks, because of particular industrial hazards, must be correlated as to time spent in the hazard, although a period of one year is, perhaps, proper for persons who feel in good health and have no complaints, or who are not working in toxic substances or with other materials which would under some conditions impair their health and usefulness.

The objectives of pre-employment and post-employment examinations are the same, that is: the establishment of a physical standard in which the employee can pursue his trade or labor, having no discomfort or ill effect due to industrial exposure to harmful products. Such products and materials are, as we have mentioned, of great number and variety. Attempts have been made to classify workmen as to age, sex, color and nationality. Whether or not any of these classifications are of value, it still remains that the primary effort is to have healthy workmen and the benefit is of as great value to the workman as to the industry. The benefits of individual and community good health are numerous and obvious; and the benefits of good health to industry are equally important. The employee will be more productive, receive higher wages and be happier. The labor turn-over rate because of poor health will be lowered as will the costs of insurance. The working personnel will be more efficient and contented, and will dislike to be exposed to the overt acts of people who are epileptic, insane or who disregard communicable disease, and will use their endeavors to work safely among hazards they have been taught to respect.

The harmful exposure to each hazard is, of course, different, ranging from a few days as, for example, an acute poisoning from toxic gases, to that of 15 or 20 years in some of the less toxic dusts; therefore the period before re-examination for each class of employee will be different. However, individuals differ also and it is hard to state a definite period which may be satisfactory for each employee in a single class of hazard. Supervisors can often be of great value in sending employees out for physical examination whenever there is a change in appearance or work ability, or when they have been off on account of some illness, such as those self-diagnosed as common cold, lagrippe, cough, sore throat or skin irritation. Such observations should be considered, where there is not a full-time physician, and they are of the greatest value in the early determination of a susceptibility to or the beginning of an industrial disease.

We are fortunate in having had a large amount of research work done on industrial diseases, until at the present time, materials from acetaldehyde to zinc are listed, together with the processes in which they are used and the symptoms which they cause, and an estimate of the amount of exposure in nearly every case necessary to produce symptoms. It is really not too much of a problem for an interested physician to accumulate a supply of such knowledge, particularly when he knows the processes involved during the manufacturing procedure of his industry. It thus becomes relatively a routine matter of observation, together with examination for specific signs or symptoms at the time of the periodical re-examination, to obtain some degree of control of the hazard.

We cannot discuss the benefits of pre-employment examination and periodic re-examination without mentioning some of the objections to it. If a man has a disability, he naturally is anxious to keep it to himself, and in some cases we find that the workman is disinterested to a point that he would rather not know of a disability even though he has it. Certain social groups regard each man as entitled to employment whether he is physically fit or not, on the assumption that industry hires labor, not health, and that rejection because of physical disability causes a class of artisans to become prejudiced against and become charity cases. It is also alleged that the quality of medical service in industry is such that the results of examinations are misleading and of no value. Another objection is voiced by labor unions, it being claimed that pre-employment examinations are used to discriminate against labor union workers or members. Many labor leaders realize, however, that pre-employment examination and periodical check-ups are the only means of preventing disability from certain industrial hazards. Competent and honest medical service renders all these objections quite impotent; for if an endeavor is made to properly place employees, such a small percentage is finally rejected, and that percentage is so obviously unfit to work, that no fair-minded person can fail to see the justice of it.

These objections, however, are being noticed by legislative bodies, and in one State a law is in force which says: "It is hereby declared to be the policy of the legislature of this State, in enacting this article, to prohibit through every lawful means available, any requirement as a pre-requisite to employment which compels an applicant for employment in any occupation coming within the purview of this article to undergo a medical examination." This statement is in a paragraph labeled, "Prevention of Silicosis and Other Dust Diseases," and the logic of it is entirely non-understandable, even though at the present time there is no lawful means available to enforce the stated policy.

If physical examinations are of benefit to the population at large, they certainly must be to the industrial workers, who may be exposed to special hazards; periodical check-up examinations are necessary in any hazardous work or trade in order to protect the workers as well as the industry; and the benefits to the workers of proper and fair-minded examinations, in all ordinary cases, outweigh the objections.

I have purposely omitted any reference to the economics of pre-employment and periodic re-examination, which apply either to the individual or the industry. However, one of the great public health problems of today is the question of the cost of medical care. If industry assumes some of this cost by periodical examination in connection with the prevention of industrial disease, it relieves the individual of this responsibility and allows more room in his budget for the care of his family. The benefits to industry, of course, are those of a better personnel and a lower rate of insurance. This rate, due to industrial disease hazards, is in many States very high and the logical conclusion is that the real remedy lies in the prevention of industrial disease by any method, one of which, I believe, is pre-employmnet and periodical examinations.

What Can the Engineer Do to Eliminate the Hazards of Occupational Diseases?

By REUEL C. STRATTON
Supervising Chemical Engineer, The Travelers Insurance Co., Hartford, Conn.

If I were asked, "Can the engineer prevent the majority of occupational disease cases" my answer would be, "yes." Obviously, with the exception of those diseases brought about through a sudden or accidental contact with a poisonous material or a virulent disease-producing organism, if the exposure were controlled by engineering technique, then there would be no occupational disease.

The engineer must rely upon the medical director to place individuals capable of working in hazardous occupations and to assist him in controlling these individuals through periodic physical examinations when the men are exposed to occupational disease hazards; but the engineer alone is responsible for reducing generation of harmful substances and for the control of employees' contact with processes using harmful materials.

The ascribing of many and new occupational diseases to industrial environment has produced a problem for him. The engineer generally works with materials which he can see, but the study of industrial disease control may require the handling of invisible materials. It is a common fault to focus attention upon one object to such an extent that others of equal importance may thereby be relegated to obscurity. Today safety engineers and industrial hygienists are concentrating their attention upon diseases caused by the inhalation of dust, but I do not believe the safety engineer is warranted in confining himself to the prevention of diseases caused by dust alone. His consideration should extend to include all materials produced in any manner that they may cause an effect upon a worker. The question of whether a material exists as a gas, a vapor, or a dust is but one of particle size and chemical make-up.

He must not forget that many such diseases are produced by exposure to vapors and gases as well as to dust, and that the control of these industrial diseases may be brought about by the application of certain fundamental principles common to all.

While the problem confronting individual safety engineers varies according to the industry, there are certain fundamentals common to all such problems which provide a workable basis upon which an occupational disease prevention program may be developed. Once these fundamentals are set in motion toward a safe working environment, continuance is much the same whether the engineer is engaged with a large organization or with a small one. The fundamentals follow this sequence:

(1) An occupational disease inventory is required.

(2) A plan for correction of the exposures shown by the inventory requires development.

(3) A concentrated attack upon the major exposures first, following through until all are corrected or eliminated.

An inventory of all materials used in a plant will astound the average engineer. He will find many items about which he may have little or no knowledge. He may be confronted with items he had not recognized previously, even though he has been associated with the plant perhaps many years. When this inventory is complete, he should card index it, placing against the name of the material the health hazard associated with it both from a material and a process viewpoint. Such a card index should contain the component parts or constituency of compounds.

Process exposures should be studied in conjunction with hazardous materials. Assistance in compiling such data may be obtained in the bulletin "Occupation Hazards and Diagnostic Signs," prepared by Dublin and Vane of the Metropolitan Life Insurance Company, and in a publication of the United States Public Health Service, Public Health Bulletin No. 216, "The Potential Problems of Industrial Hygiene in a Typical Industrial Area in the United States."

In addition the engineer should obtain all available information upon the materials he is required to study. New chemicals, solutions, dusts, degreasing agents, condensation products, paints, lacquers, dyes, abrasives, and other products too numerous to mention are being placed upon the market daily, and the average engineer's knowledge of their possible effects upon health is slight. Academic research determining the effect of these new materials upon humans is progressing slowly, and serious injuries may be sustained in industrial application long before the toxicologist is able to determine the properties of the material and the maximum permissible amount to which a worker may be exposed. In seeking this information it is essential to determine in so far as possible the maximum permissible amount of contaminants which may exist in a work place without causing an occupational disease.

Armed with this information, the engineer is in a position to locate properly in his own plant the process and the operation in which the exposure may exist. The engineer should study together with the plant physician the length of employment of exposed individuals and they should jointly determine the normal expectancy or average length of employment for the specific exposure. From such data may be developed a factor of safety, and the maximum allowable period of employment in certain areas may be assigned. Naturally this study should be focused upon the more hazardous locations first, and when these are corrected, attention turned toward minor conditions.

Housing. One of the most important considerations in attempting to control occupational disease is housing. Whenever practical, any hazardous manufacturing process should be separately housed and isolated; every effort should be made to arrest harmful substances—dust, vapors, or gases—at their source of generation. Buildings should be so constructed that accumulations of dust may be avoided.

When physical separation of departments is required, such physical divisions should be dust or vapor tight. Floors should be tight to prevent transfer of materials to floors or departments below. The engineer should give study to the complete enclosure of machinery or process units as individual units and, if so required, vent each one separately. The transfer of hazardous operations into the open air does not always eliminate the danger; in fact, it may increase the number of workers affected.

Process Revision. To reduce transportation of materials and exposure to harmful substances it is desirable to have all processes mechanically continuous and, if possible, enclosed. When this cannot be accomplished, suitable physical divisions should be provided. The engineer should consider the substitution of wet processes for dry processes, providing at the same time for the disposal of the moist collected material in a safe place. He should consider the substitution of automatic operations for hazardous hand work or machine work. A change of abrasive material will often reduce the quantity of dust produced.

I can cite an example of how a little thought can cure a hazardous machine operation with little or no expense:

A plant producing a finely pulverized material created large amounts of dust in bagging the material, using porous sacks. This high concentration of dust, not necessarily toxic, inconvenienced the workers. The cost of ventilating the department would have been prohibitive. By careful study the engineer determined that the fall of the material into the sacks forced the air out through the interstices of the material, carrying with it a quantity of the pulverized product. His problem, thus, was to provide a means whereby this air could be harmlessly expelled from the sack prior to filling. Study led him to suggest and apply the use of a collapsed paper bag which contained little or no free air. The problem was solved. Dust generation was practically eliminated by this simple change. Many hazardous processes in ordinary manufacturing operations may be cured in like manner if the engineer exercises his ingenuity.

Ventilation. Proper ventilation is of paramount importance in the control of any occupational exposure. Most of the chief occupational diseases other than dermatitis arise through the inhalation or the ingestion of foreign material. If ventilating equipment can reduce the concentration of contaminating materials to a safe limit, the problem is solved. The engineer should study each process separately and ventilate each separately. It is seldom wise to rely upon general ventilation. Instead, high velocity ventilating apparatus should be installed, functioning as closely to the point of generation of the harmful substance as is possible.

Individual machines should be so equipped if possible. Baffles may be introduced to prevent air stream disturbances or to increase the intake efficiency at the nozzle. Down-draft systems should be preferred for the collection of dust or gases of high specific gravity.

Even after the installation of exhaust systems, the engineer must study the type of maintenance required to keep them operating at peak efficiency. Nozzles should not be permitted to become covered nor moved out of proper position. Exhaust piping must be kept dust tight. Blower efficiencies must be constantly checked to insure that intake velocities are proper. The best ventilating system is a false protection if it does not function properly or if it is so poorly maintained that it falls below its designed rating. The engineer must exercise extreme care to provide a clean source of replacement air for the work place. He may find it necessary to install filtering and heating devices. The engineer must study the proper disposal of the collected or expelled material to be positive it will not drift back into the work place.

Employee Protection. While the primary engineering means of protection against possible occupational diseases should be mechanical correction, the engineer will find instances where even the best systems must be supplemented by individual protection. He must carefully study such exposures to provide the highest efficiency of protection, yet obtain a device easy for the operator to wear continuously. When the engineer has been successful in obtaining such a device, he must educate workers to use it.

Sanitation. Clean washing facilities and toilets should be provided. Lunch rooms should be not only clean but also well lighted and attractive and should be under the supervision of the plant physician.

Scientific Tests. Up to this point the engineer has deduced that an exposure exists, and from accumulated data has devised his means of prevention. However, the engineer interested in ascertaining not only exposure but also efficiency of control should realize control cannot be fully effective nor the efficiency of any protective device determined without scientific tests. Assumption, guesswork, unscientific procedure or apparatus have no place in an engineering program. The engineer must test each step unless it has been previously proved, carefully calculating in advance to avoid false protection.

He must be familiar with dust counting, air sampling, and chemical analysis technique, having such determinations made by established and proper methods. If such tests are beyond the scope of his ability or equipment and if the engineer considers such tests absolutely essential, then his executives should permit him to obtain experts qualified to make such surveys as his problem may require. The need for an accurate engineering approach to any control measure cannot be overemphasized.

Conclusion. Every engineer realizes control of any industrial disease exposure is divided, part of such control falling within the jurisdiction of the industrial physician and part within his own engineering province. Medical knowledge is invaluable in the detection of early symptoms and in the administration of suitable preventive treatment. The engineer should gladly obtain the services of an industrial physician to make a study of the plant, to assist in the classification of the hazardous operations and working locations. By such coordination he will speed control of the exposure.

Each individual occupational disease exposure must be studied, analyzed, and controlled individually. While general data may be available upon common exposures, the solution can be found only in individual treatment. Such exposures cannot be compared to ordinary safety engineering efforts. A circular saw is a circular saw wherever it may be operating, but industrial disease exposure varies within plants and certainly varies between different manufacturing establishments, even though they may produce a like product or article.

ADJOURNMENT