FILE NAME: Insurance Industry (INS)

DATE: 1957

DOC#: INS101

DOCUMENT DESCRIPTION: Report - Survey of the Occupational Environment - Health Hazards [Author Herbert Walworth worked for Lumbermen's Mutual]

The survey of

This report was prepared by the subcommittee to revise "Plant Hygiene Studies" of the Committee on International Relations, Council on Industrial Health, American Medical Association. The following persons are the members of the subcommittee: Warren A. Cook, Chairman, William G. Hazard, Herbert T. Walworth, Irving R. Tabershaw, M.D., and Jerome K. Brash.

Introduction

This treatise is intended primarily for those physicians who serve industry on call; those physicians whose private clientele includes industrial employees; and those to whom industrial employees come for pre-placement, periodic, or other types of physical examination, diagnosis, or treatment. Its purpose is to promote greater interest, knowledge, and activity in occupational health on the part of all physicians who are, or should be, concerned. Full-time industrial medical directors and staff physicians presumably are well acquainted with the matters discussed, as are most physicians occupying such positions part time. However, they might find in this treatise worthwhile reminders.

The physician may gain much through a personal survey of the occupational environment of persons who are under his supervision or of those who are or may become his patients. Increasingly in the large plant and especially where there is a well-organized medical department, the industrial physician observes operations and the conditions under which the employees are working. This practice should be adopted by the physician who has an "on-call" relationship with industrial plants. After each survey, the physician should discuss his observations with management with particular recognition of the fact that the assistance of several disciplines is usually necessary to control a given situation.

General practitioners whose patients include industrial workers can and should acquire some knowledge of the industrial operations of the area through organized plant tours or invitational open-house arrangements between the industries and the local medical society.

cupational environment

an essential of industrial medical practice

Manifold advantages are to be gained from a survey of the occupational environment. The information obtained may permit the physician more adequately to diagnose and treat disease affecting his patient. As an example, a persistent hepatitis may fail to respond to treatment. Inquiry into the patient's occupation may disclose exposure to a chlorinated hydrocarbon solvent vapor as the possible cause. Only after this exposure is evaluated and brought under satisfactory control can the patient's hepatitis be alleviated and, of equal importance, development of hepatitis in other workers at the operation be avoided.

Similarly, the survey permits the physician to become familiar with the physical and mental demands of the job. It gives him the opportunity to see the people at work, in circumstances in which they are much more likely to be at ease than in his office. In addition he can become acquainted with materials and operations, the nature of exposure to substances and conditions that may affect health, and the physical conditions that may be the cause of accidents. It is important, however, at this point to caution the physician against hasty and unsubstantiated conclusions.

The physician is thus in better position to help in matching the physical abilities of a prospective employee with job requirements. He has a better understanding of the industrial health hazards as they actually exist in a given plant and at a specific operation. This knowledge of the environment permits him to take a more effective part in the prevention of occupational diseases and in accident prevention. What then is the first approach in making an initial survey of a plant and what should be looked for?

Preliminary to the Survey

Arrangements for an initial plant survey should be made invariably with management or an appropriate representative of management. Where the plant is small, there should be a discussion of the purposes of the survey with the head of the concern and the physician serving the plant. If the plant is a division of a larger organization, inquiry should be made through local management as to whether there is a medical director or consultant who supervises occupational health throughout all plants. If so, the physician should communicate with him. Both management and medical advisors would be expected to welcome such interest in plant conditions on the part of a general practitioner or on-call physician. In preparation for the survey, the physician should acquaint himself with the workmen's compensation act and the industrial health and safety regulations of the state.

In the actual conduct of the survey, management should designate someone familiar with the plant to accompany the physician through the various departments. In the larger concerns the safety director or the industrial hygienist would be the logical selection, since he would be well informed as to operations and potentially hazardous conditions, and as to the means of safeguarding workers against them. Prior to making the trip through the plant, the physician should discuss conditions with the person who is to accompany him.

A review of plant dispensary records should be made with special reference to minor complaints and injuries as well as lost-time injuries. It is to be hoped that there may have been some analysis of these data relative to major causes of injury, preferably in accordance with the code of the American Standards Association.[1] Special note should be taken of symptoms or complaints reported, particularly if recurrent in the same person or in different persons in the same department. If periodic physical examinations have been made, positive findings that may be associated with occupation help to point out those operations especially to be noted in the survey.

The Survey

Several types of surveys that vary in their purposes and thoroughness are well discussed by Patty.[2] He not only notes the information that should be gained in these surveys but also includes pertinent comments on proper conduct within the plant on the part of the person making the survey.

Conditions to be watched for are described briefly in the following paragraphs. Where such conditions are found, the physician should become more completely informed through references such as are listed by the Council on Industrial Health of the American Medical Association.[3]

Injurious Materials

Dusts (Pneumoconiosis).—The hazard presented by dust in an occupational environment is dependent on a number of factors. It is necessary first to know something of its composition. Abrasive blasting may involve free silica in the form of quartz if a flint or sand abrasive is used. In this case, the dust exposure of the worker must be kept at a low level if silicosis is to be avoided. On the other hand, where steel abrasive is used to remove scale from steel forgings, the dust contains no silica and consequently need not be kept under as meticulous control as in the former instance.

The maximum amount of dust that can be considered acceptable depends not only on its composition but also on its particle size and the duration of exposure. Generally, dusts present in work atmospheres include appreciable proportions sufficiently small to reach the alveoli. The exceptions are rare. In regard to duration of exposure (not only to dusts but to other hazardous materials), an operation may be observed to be brief, but inquiry should be made as to whether it is repeated during the day, and how often. Where production involves a number of diverse operations, it is well to inquire whether activity at other periods during the day or week may involve exposures greater than those observed.

The dusts most likely to produce disabling pulmonary involvement are those containing free silica, that is, silicon dioxide not chemically combined with other elements. Such dusts occur frequently in industry. Inquiry should be specific in regard to this component, especially since the presence of free silica may not be readily apparent. For example, soapstone powder, widely used to keep layers of unvulcanized rubber from sticking together, may contain from 0 to 17% of free silica, depending on its source. The most common form of free silica is quartz, which occurs widely in nature. Natural materials widely used in industry that should be regarded as potentially productive of silicosis because of their high free-silica content are granite, flint, sandstone, sand, tripoli, and diatomaceous earth.

Dusts containing asbestos should also be noted, because prolonged exposure to asbestos dust in excessive concentration may result in a type of pneumoconiosis known as asbestosis, which may be disabling. In coal mining and handling, attention should be given to the possible development of coal workers' pneumoconiosis, a recently recognized but incompletely explored clinical condition due to exposure to coal dust, per se, as well as to the possibility of silicosis from exposure to free silica in the rock associated with the coal in certain areas.

Metals and Their Compounds.—A large number of metals and their compounds are used throughout industry. As a potential industrial health hazard, the most prominent of these is lead, which may be present alone or in a wide variety of compounds. The chief mode of entry is inhalation of dust or fume. Percutaneous absorption of metallic lead and inorganic lead compounds is insignificant, but tetraethyl lead and a few other organic compounds of lead may be absorbed through the skin under suitable conditions. Molten lead ordinarily does not present a hazard unless its temperature is well above its melting point. Special attention should be given to operations where lead may be subjected to temperatures above its boiling point, as in the welding of leaded steel. It is wise to have persons who work regularly with lead checked periodically for the extent of their lead absorption by determination of lead in blood or urine.

Lead compounds may be known by a number of names not including the word lead. Litharge, the common name for one of the oxides of lead, is found in the paste of lead storage battery plates, in a cement for attaching glass to metal, in "doctor" solution in petroleum refining, and in the manufacture of chrome yellow pigment. Although the specific gravity of this compound is high, litharge is often so fine that when dispersed into the atmosphere it will persist long enough to cause excessive exposure if adequate control measures are not in effect. In most industrial operations where dusty lead compounds are used or produced, it is desirable to have an evaluation of the exposure made with the aid of laboratory analysis of the air or of samples of the blood or urine of exposed employees, or by the combined investigation of the environment and the personnel.

Other toxic metals to which the physician should be particularly alert include antimony, arsenic, beryllium, cadmium, cobalt, manganese, mercury, and phosphorus. Exposure may occur in mining, metal-refining, fabrication, and metal-cleaning operations. Welding or high-temperature cutting on cadmium-plated surfaces can be particularly hazardous. The toxicity of beryllium is so extreme that it is in a category of its own. Mercury is of special importance because hazardous concentrations of vapor are released from the liquid metal even at room temperature. The dust of various mercury compounds is also toxic. Chromium in the form of chromic acid mist is commonly found in chromium electroplating or as salts of chronic acid in the form of dust, and may cause ulceration of the skin or the nasal septum. Zinc in the form of fresh zinc oxide fume, such as may arise from a bath of molten zinc at a galvanizing operation, may cause the temporarily disabling illness known as metal fume fever.

Excessive exposure to iron dust or fume as produced in welding, gas cutting, or grinding may cause sufficient retention in the lung to show as nodulation on chest films, but the condition is not regarded as disabling. These changes are somewhat erroneously interpreted as silicosis.

Whereas the pneumoconiosis-producing dusts usually require prolonged periods of exposure (years) to produce

their effects, very brief exposures to toxic metals, solvent vapors, and gases can cause illness. Thus it is important that the physician be alert to the possibility that operations of brief duration may entail exposures more severe than those observed at the time of his survey.

Solvents.—In observing operations involving solvents, the physician should consider the possibility of absorption through the skin, in addition to absorption through the respiratory tract. Contact of these materials with the skin not only provides an avenue of introduction into the body but also presents the possibility of dermatitis.

There is a wide range of hazard potential among the many solvents used in industry. This is governed by the volatility of the solvent as well as by its toxicity. The exact chemical name of the solvent should be obtained. This need is illustrated by the two solvents, tetrochloroethylene and tetrachloroethane. There is only a slight difference in their names, but the toxicity of the former is indicated by a maximum acceptable concentration in the atmosphere of 200 parts per million as against 5 ppm for the latter—and they are of essentially the same volatility.

One of the frequent uses of solvents in a great variety of plants is in equipment known as the vapor degreaser. This is essentially a tank in which a solvent, often trichloroethylene, is vaporized by heating, and metal parts to be degreased are placed in the hot vapor. Such equipment can be used without excessive exposure to the operator, but a considerable number of poor practices, as listed by Horowitz,[4] can result in exposure beyond the recommended limit. Benzol (benzene), carbon tetrachloride, carbon disulfide, and methanol are other industrial solvents that may cause serious illness if not used under properly controlled conditions.

Gases.—In general, potentially hazardous exposure to gases is not obvious in occupational environments. For example, a visit to a gasoline engine test room may fail to indicate the presence of a moderate carbon monoxide hazard. Where carbon monoxide may occur by leakage from a pipe line, or by impingement of a gas flame upon a cold surface with resultant incomplete combustion, or by its use as a reducing gas in a heat-treating department, inquiry should be made into the occurrence of headache among the employees such as would result from moderately elevated concentrations over a number of hours or throughout the day. In addition, the possibility of accidental liberation of high concentrations that may result in asphyxiation should be kept in mind.

These two elements of hazard apply to exposure to a number of other gases. The more prominent symptom from moderately excessive exposure to hydrogen sulfide is irritation of the eye rather than headache, but the danger of rapid asphyxiation is even greater than that from carbon monoxide. Experience has shown that the odor of hydrogen sulfide is no safeguard against excessive exposure, because even brief exposure to sufficiently high concentration results in the loss of the ability to smell this gas.

A number of gases are brought into plants in cylinders in the form of liquids under pressure. These include hydrogen fluoride, used in certain oil-refining processes and in the chemical industry; hydrogen cyanide and methyl bromide, both used for fumigation and for other purposes; and chlorine, widely used for bleaching, in water treatment, and as a bactericide. Other toxic gases include ozone, nitrogen dioxide, and sulphur dioxide.

Dermatitis-Producing Materials.—The phase of the survey dealing with dermatitis-producing materials may best start with the industrial nurse who probably will be well informed of the incidence of dermatoses. For example, if no cases from cutting oils and compounds have come to her attention, this source of dermatoses may require no further investigation, but, if numbers of minor cases with an occasional serious case have occurred, this situation should be thoroughly investigated. Attention should be given to washing facilities, soaps and cleansers used, and the availability of hot water. Personal washing procedures as well as other measures such as protective creams and equipment should also be checked.

In addition to solvents, innumerable other primary irritants and sensitizers cause skin infections. Wherever there is skin contact with primary irritants, which may include not only strong acids and alkalis in an electroplating department but even dishwater in a plant cafeteria, there may be some incidence of dermatitis. Skin contact with such materials should of course be avoided, though this is difficult in some operations.

Among the many sensitizers, exposure to those involved in the preparation of synthetic resins and in the manufacture of plastics is worthy of note. The effect on the skin may be caused by contact either with dust or with gases liberated during these processes.

Where waxes are used for impregnation of electric condensers or for wire and cable insulation, inquiry should be made as to whether these are chlorinated naphthalene or diphenyl compounds. If so, suitable precautions (often listed by the producer) should be followed.

Pathogenic Micro-Organisms.—A number of occupations involve exposure to pathogenic micro-organisms, through their incidental introduction into lacerations. In packing houses, measures to avoid brucellosis and psittacosis should be noted. In plants that handle imported animal products, such as hair, bristles, wool, and hides, investigation should be made of the need for sterilization of these materials and, if in order, the method used. Workmen in these plants should be told what an anthrax pustule looks like and impressed with the need for immediate medical attention for such a lesion.

Other Materials.—Materials other than those falling within the foregoing classifications should not be overlooked. Examples of such materials are those capable of inducing cancers, including chromium compounds (lung) beta-naphthylamine and benzidine (urinary bladder), and certain polycyclic hydrocarbons that may be present in coal tars and in certain high-boiling catalytically cracked oils (skin). Surveys of industrial exposure to the cancerogens should be supplemented by epidemiological investigations. A single case of cancer hardly proves a cause-and-effect relationship where exposure to a suspected cancerogen is involved, but incidence of such cases significantly in excess of that occurring in the general population would point to the occupational exposure as a possible cause.

Hazardous Conditions

In addition to hazardous materials, observations should include hazardous conditions. These may be covered under the following headings.

Excessive Noise.—Exposure, particularly of long duration, to excessive noise levels may cause diminished acuity of hearing. Although sufficient data are not yet available on which to specify a precise level of sound of a given frequency that can be taken as a maximum acceptable level, certainly those noise conditions where one must shout within an inch or two of the ear to make oneself heard should be noted in a survey of potentially injurious conditions. The physician, upon finding such conditions, should recommend that a study be made of the noisy environment to determine whether the intensities at existing frequencies are excessive and, if so, to determine whether practical noise-reduction measures can be taken. He might also recommend that an audiometric examination program be instituted.

Extremes of Atmospheric Pressure.—Extremes of atmospheric pressure include the high pressures encountered in foundation and tunnel construction, and in diving operations, and the low pressures of flying at high altitudes. Foundation and tunneling operations under pressure tend to be among the more hazardous.

It is likely that a full-time or part-time physician will be connected with such construction operations. Other physicians in the area may be called upon because of some temporary unavailability of the physician normally responsible, or in event of an accident causing a number of serious injuries. Also their patients may be engaged in such work. Accordingly it is desirable for physicians in the area to visit the project, become informed on compression and decompression schedules, and become familiar with the physical examinations given new workers and with instructions to workers such as checking with the physician before going under pressure in case of a coryza or ear block. Particularly where high pressures are used, the physician should become completely informed on operating conditions before he decides to enter a pressurized area. It would appear prudent for only the younger physician to do so.

In aviation medicine, it is now generally accepted that physicians should be familiar with the effects of low pressures and of too rapid subjection of the body to pressure changes.

Low pressures from high-altitude construction or mining operations are not ordinarily within the purview of most physicians. It is assumed that physicians at operations in such locations will be informed about the physiological aspects of working and living under low pressures—also about the decrease in maximum acceptable concentrations of gases, dusts, and toxic materials, as larger volume of the thinner air must be respired.

Extremes of Temperature: Heat.—In many plants the problems of heat in summertime are no different from those in nonindustrial environments generally. Since the evaporation of perspiration causes cooling of the skin, usually the better the air movement, the greater the comfort. Although high humidity in itself creates no harmful effects, it does limit the rate of evaporative cooling of the skin and can be expected to intensify the effects of high temperatures.

Many plants have local "hot spots," such as ovens, heat-treat baths, and furnaces, that cause excessive exposure to radiant heat as contrasted with heat carried by convection, or hot air. In the steel, glass, foundry, and other industries where processing is built around large-scale melting operations, control of radiant heat is a major problem.

A given amount of heat transferred to a man will have the same effect regardless of the means by which it reaches him—convection, conduction, or radiation. But the control of radiant heat is totally different from the control of the others. If a man is subjected to radiant heat, air movement over the man will not reduce his heat load. Shielding with some reflective material such as aluminum may be required.

The physician should become acquainted with the high-temperature occupations in a plant. Workers with certain circulatory defects should be placed elsewhere. Since long-term physiological effects of working in heat do not seem to be serious and acclimatization is a very real factor, the physician would ordinarily refrain from recommending the alternating of workers between hot and normal-temperature operations.

An increase in the body temperature and pulse rate results from exposure to extreme heat. Since these effects are alleviated fairly promptly on removal to cooler areas, the physician should note whether such areas are available and utilized as required. If an air-conditioned rest room can be provided, recovery is considerably more rapid.[5] When the pulse rate does not decline sufficiently during a rest period in a cooler area, more effective control measures should be recommended.

In hot occupations the physician should observe whether an adequate water supply, with salt, is available for the prevention of heat cramps and exhaustion. Salt is usually taken in tablet form. Several varieties are sold, but the enteric-coated or impregnated type seems the most satisfactory. A cooled, salted water supply is sometimes used. One teaspoonful of table salt per gallon of water is adequate. Thirst is not an accurate indicator of how much water a man needs when working in extreme heat. His fluid loss will usually exceed the replacement induced by thirst. It has been said that one benefit of salt tablets is that they result in a man's drinking more water than would otherwise be the case.

Extremes of Temperature: *Cold.*—Exposure to extreme cold may occur in meat-packing plants, in deep-freeze food producing and storage operations, and in flying at high altitudes. Provision of proper clothing is the principal factor to be noted. It has been stated[6] that acclimatization to cold has not been satisfactorily demonstrated. An investigation[7] of a group of 66 workers engaged many years in preserved-meat manufacture in cold rooms maintained at 0 to 2C showed a high incidence of chronic muscle and joint pains, and of upper respiratory tract involvement. Inquiry should be made of these possible manifestations of the effects of cold by the physician concerned with such exposure.

Ionizing Radiations.—Ionizing radiations are finding increasing applications in industry. Inqury should always be made as to whether radioisotopes or x-ray units are being used or whether it is contemplated they will be introduced. Some years ago industrial radiology was limited principally to the use of radium or x-ray for making radiographs of welds and metal castings for detection of flaws. Today a considerable number of radioisotopes are employed for a variety of purposes. Cobalt-60, a powerful gamma emitter, may be used instead of radium for radiography or it may be the source of gamma radiation in recording devices for liquid levels, or in a pipe-thickness gauge. Beta emitters such as phosphorus-32 may be found in thickness gauges for application of rubber coating or in milling of aluminum foil. Even alpha emitters have an industrial use where polonium-coated bars remove static electricity from printing press rolls and other machinery where static inter-

feres with production or safe operation. Radium also continues to be used for this latter application. The risk of inhalation or ingestion of radioactive materials, particularly alpha emitters, should be checked. Radioactive sources and devices utilizing ionizing radiations can be used with safety where adequate precautions are observed.

The physician need not be an expert in the intricacies of ionizing radiation, but he should inquire into the schedule of monitoring exposure to radiation, and review the records of radiation levels within occupied areas and of personal monitoring devices. If exposure should exceed accepted values, he should call to the attention of management the seriousness of the injury that in time may develop. Factors involved in the proper handling of radioisotopes are outlined in a paper on surveying industrial plants for safe use of these materials.[8]

Illumination.—In making a survey of any occupational environment, the adequacy of illumination should be observed. This would include intensity for a given operation and area, together with quality of illumination. This latter factor includes contrast, lack of glare, and proper brightness ratios, in respect to both artificial and daylight illumination. It is not contemplated that a detailed illumination survey will be undertaken by the physician. If his general observation indicates that the illumination is inadequate, the plant management should be referred to publications on industrial illumination[9] and advised to have an illumination survey made. In connection with the relationship of illumination to the visual demands of tasks, attention should also be directed to an adequate eye-examination program, and to suitable eye-protection equipment as well.

Harmful Operations

Repeated Motion.—Injury may be caused by repetitious movements. Attention should be given to operations that may lead to bursitis and synovitis. Information may be obtained from the plant nurse as to whether such conditions have occurred and, if so, at which operations. The physician may be able to make pertinent suggestions for adapting the operation to the physiological and anatomic limitations of the human body.

Vibration.—Compressed-air-driven hand tools are widely used in industry. In many plants the intermittency of the operation or other factors have prevented difficulty. If there has been some incidence of "white fingers" or if these tools are used routinely, reference may well be made to a paper by Dart[10] that covers this condition from the viewpoint of a practicing industrial physician. Heavy pneumatic tools such as jack-hammers reportedly may cause injury to elbow joints, but in this country cases have been few.

ACCIDENT HAZARDS

Operations and Conditions.—If the survey is made in company with the safety engineer, more attention may be given to accident hazards. A check list of operations and conditions to be noted is given by Blake.[11] Unsafe acts of workers account for a greater number of injuries than do environmental conditions and machines, but both factors are involved in the majority of accidents. Information on accident hazards and their control can be gained by a review of the accident experience of the plant and through the plant survey, and also by attending plant safety committee meetings.

SANITATION

General.—The American Standard on Sanitation[12] serves as a guide to general sanitation facilities. The physician should obtain information as to the state and local code requirements. Adequate maintenance and proper use of these facilities should be emphasized. Where difficult-to-remove materials get on the skin, the physician should learn what is provided for skin cleansing and in addition should observe what is actually used. Many a case of dermatitis is caused by use of solvents and harsh abrasive cleaners, even in plants where proper washing facilities and cleaning agents are provided.

Food Handling.—Whether food handling is directly under the plant management or is the function of a catering service, the physician should observe the methods utilized. If foodstuffs are prepared outside the plant premises, the survey should extend to such locations. Methods of refrigeration and of keeping hot foods above the temperature of bacterial germination should be noted. One should inquire into use of foodstuffs after they have been standing in serving areas during mealtime. Garbage disposal should be checked. The storage and use of pesticides in and around food handling and storage areas should be inquired into carefully.

Not only is sanitation of importance in in-plant food handling areas, but also the nutritional adequacy of foods served by the cafeteria and selected by the employees should be checked. It is difficult to change eating habits, but, where food served appears to be nutritionally inadequate, this should be investigated and then proper recommendations made to management. A threefold approach might be suggested through offering balanced meals; making them attractive; and educating personnel in food selection, particularly those greatly underweight or overweight, as well as the diabetics and others who have to watch their diet carefully.

Hazard Evaluation

The general survey of a plant will disclose some operations where hazardous materials are used under obviously safe conditions. Other operations may as obviously be hazardous and call for a recommendation to management that control measures be instituted.

In many instances potentially hazardous operations may be in progress that may or may not cause injury, depending upon the severity of the exposure. Control measures may be costly and management may be reluctant to incur such expense just to "be on the safe side" especially where competitors may not be adding the expense of such control to the cost of their product. In such a case, the question of whether a hazard actually exists may best be answered by recommending that the plant avail itself of expert professional survey services, which may include tests for atmosphere contaminants or of such biological materials as blood or urine, and recommendations for methods of hazard control based on their experience and technical findings.

Such services are available through official departments of industrial hygiene or occupational health in most of the highly industrialized states and in certain of the larger cities and counties. Private sources of these services are available and include a number of the larger casualty insurance companies, full-time consultants, and various professional and research organizations in the field of industrial health, including a number at universities.

RECORDS OF CONDITIONS IN OCCUPATIONAL ENVIRONMENT

After the survey of the industrial environment, the physician should report to management his observations and recommendations. It would also be helpful to the physician to prepare his own record for his use concerning job requirements and health hazards in the plant.

This record should include the potentially injurious materials used or otherwise present; something of the intermittency or duration of exposure to them; and whether the exposure was normally under good control, obviously requiring control, or in need of technical study for its evaluation. The operations involving the potentially hazardous materials or conditions should be listed. A graphic means of associating hazardous materials and conditions with operations or departments consists of a chart on cross-section paper with the materials and conditions along the ordinate, operations or departments along the absicissa, and notations at the intersections indicating existence of the hazard at a given operation or department.

Control Methods

The survey of the plant should include a consideration of control measures, both medical and engineering, which are or should be followed in maintenance of a healthy work force and healthful working environment. It is not proposed that the physician include engineering control as part of his activities. However, an understanding of the engineering factors involved in the control of health hazards will enhance his appreciation of the over-all health aspects of plant operation. The more common control methods are as follows.

MEDICAL CONTROL

Preplacement Examination.—The physician should ascertain the scope of the preplacement examination of all applicants for work and of special examinations of employees who are to be placed in an occupation involving exposure to some hazardous material. For example, employees to be placed in occupations involving exposure to pneumoconiosis-producing dust should be given a chest x-ray and those to be exposed to toxic substances should be given the same clinical tests that will later be used in periodic examinations, to provide base-line values.

Periodic Examination.—The physician should also ascertain which special procedures are included in periodic examinations of employees in hazardous occupations and the interpretations of the findings. If the findings point to possible health impairment, inquiry should be made as to what conditions in the plant are to blame. The intervals at which these special procedures are conducted should be determined by the severity of the hazard and modified as the hazard is brought under control. The interval between chest x-rays should be related to the period required for the development of detectable changes.

Where a medical control program has been set up by one physician, it is advisable that another making a survey of the plant discuss his observations with that physician.

ENGINEERING CONTROL

Purpose.—The physician making a plant survey has a proper interest in engineering control measures for a number of reasons. The decision of the physician in recommending the placement of a worker at a given operation or retaining him at his accustomed occupation may depend upon the engineering control measures. The physician may have completed an initial x-ray survey of a foundry group and among the core finishers noted one man with arrested tuberculosis. As foundry work is considered by many a physician to be a laborious, hot, dusty occupation, the first thought on reading the x-ray may be that this man may better be placed in some other industry. Consultation with the safety engineer or industrial hygienist or personal survey of this employee's workplace may disclose that his job is conducted while he is at a bench equipped with well-designed local exhaust ventilation, obviously resulting in no appreciable exposure to dust. On the other hand, if an employee subject to asthma is exposed to an organic dust to which he is allergic, and the only feasible control measure is a filter-type respirator (adequate protection for the man's fellow workers), the physician might well recommend that this man be placed in a more suitable location in the plant.

The interest of the physician in engineering control serves as a stimulus to the production and maintenance departments for provision of adequate control measures.

The production superintendent is occupied with getting out the product; plant maintenance departments have a backlog of work that a foreman or superintendent is pushing to get done. Provision for control of health hazards is often deferred to the next day, and the next. The physician, in observing the state of control measures, might note that the elbow in an exhaust pipe was eroded and leaking, and find an explanation for the recurrent nosebleed of the chrome plater. When the physician emphasizes need for repairing the ventilating system through the proper channels, it is probable that action will be taken promptly.

Types of Control Methods.—A number of categories of engineering control measures may be applied to reducing to safe levels exposure to hazardous materials. Where substitution of a less hazardous material is feasible, this should be done, for example, toluene for benzene as a paint diluent.

Alteration of method may serve as a control measure. This may involve a minor change such as installation of a motor-operated hoist to replace manual handling of baskets at a vapor degreaser or a major change such as replacement of beehive kilns with tunnel kilns for abrasive wheel calcining. In the latter case, the dust exposure is appreciably decreased and, in addition, efficiency of operation and quality of product are improved.

Isolation has application at many operations. One of these is the use of radioisotopes in well-shielded enclosures, with mechanical devices manipulated from the outside.

Ventilation is the most widely used method of engineering control. General ventilation refers to movement of air from an entire room or building. Local exhaust ventilation is usually more effective, since it is designed to capture the contaminating dust or gas before it escapes into the general room atmosphere.

Wet methods may serve as an effective means of dust control in certain operations. This may involve merely the use of garden watering cans to sprinkle the earth floor around a foundry molding area, or the installation of a high-powered water-sand blast for removal of cores from castings in place of the dusty operation of using pneumatic chisels. Good housekeeping, in itself, is an important control measure.

Personal protective devices have a real place as control measures. Although respirators should not be used as an inexpensive substitute for a local exhaust system, they may be recommended for operations where other control methods are not feasible and where there may be a severe exposure for a brief period. They may be used also as a supplement to other control methods. The type of respiratory protective device selected is extremely important and the physician would do well to learn specifically about the applications and limitations of such devices. Where toxic dusts or gases are present, or where the atmosphere is deficient in oxygen, devices approved for the particular exposure by the U. S. Bureau of Mines and as listed in their reports[13] should be used. Personal protective devices also include goggles, hard hats, gloves, plastic sleeves, asbestos leggings, and clothing made of aluminized fabric to ward off extreme radiant heat.

Conclusions

The purpose of this discussion has been to stimulate the interest of the physician in making surveys of plants with which he may be in contact, to suggest the manner in which he should approach such a survey, and to indicate the nature of conditions that should have his attention during the survey.

The facts obtained should influence the nature of the medical examination given workers, and findings of an examination should be interpreted in the light of such information. Care should be exercised in arriving at conclusions until there has been sufficient examination of all the facts. The mere presence of a toxic agent does not necessarily mean that the exposure is excessive or that injury will occur.

Examples of potentially hazardous materials and conditions, and the operations with which they are associated, have been included, but it is urged that the physician consult reference sources for more complete details. This will place him in better position to appreciate what he sees during the survey and help him in constructive discussion with management.

REFERENCES

1. American Recommended Practice for Compiling Industrial Accident Causes, Z16.2-1941, New York, American Standards Association, Inc., 1941.

2. Patty, F. A.: Industrial Hygiene and Toxicology, New York, Interscience Publishers, Inc., 1948, vol. 1, pp. 29-40.

3. Selected Publications on Industrial Health, the Council on Industrial Health of the American Medical Association, Chicago, 1955.

4. Horowitz, L. D.: Check List for Vapor Degreasing Operations, Monthly Review, New York State Department of Labor, Division of Industrial Hygiene 34: 9-11 (March) 1955.

5. Brouha, L. A.: Air Conditioning Rest Areas Reduce Physiological Stress, Heating, Piping, and Air Conditioning 27: 92-95 (Aug.) 1955.

6. Rosenau, M. J.: Preventive Medicine and Hygiene, edited by K. F. Maxcy, New York, Appleton-Century-Crofts, Inc., 1951, pp. 950-954.

7. Troisi, F. M.; Amorati, A., and Bonazzi, O.: Pathological Effects from Work in Cold Environments, Indus. Med. 22: 11-13 (Jan.) 1953.

8. Cook, W. A.: Surveying Industrial Operations Involving Radioactive Materials, Transactions of the 41st National Safety Congress, Chicago, National Safety Council, 1953, pp. 91-93.

9. American Standard Practice for Industrial Lighting, A11.1-1952, New York, American Standards Association, Inc., 1952. Recommended Practice of Daylighting, Illuminating Engineering 45: 107-139 (Feb.) 1950.

10. Dart, E. E.: Effects of High Speed Vibrating Tools on Operators Engaged in the Airplane Industry, Occup. Med. 1: 515-550 (June) 1946.

11. Blake, R. P.: Industrial Safety, New York, Prentice-Hall, Inc., 1943.

12. American Standard Minimum Requirements for Sanitation in Places of Employment, Z4.1-1955, New York, American Standards Association, Inc., 1955.

13. Pearce, S. J., and Berger, L. B.: List of Respiratory Protective Devices Approved by the Bureau of Mines, Information Circular 7636, United States Department of the Interior, Bureau of Mines, 1952.

This Committee Report was approved for publication by the Council on Industrial Health. B. Dixon Holland, M.D., Secretary. Reprinted from J.A.M.A., Dec. 8, 1956.