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Industrial Health

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Air Contaminants That Affect Health

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DURING the development of present knowledge of the influence of air contaminants on health, naturally many theories were advanced that later scientific work has modified or displaced. However, not always has the correction been as widely and thoroughly disseminated as was the original theory; this condition, perhaps, has led to some confusion.

There are available different published classifications of dusts. Included in such classifications are dusts the exposure to inhalation of which is, or is likely to be, occupational. Of dusts which are inherently toxic when inhaled or otherwise absorbed and which cause systemic poisoning, examples are lead, arsenic, mercury, manganese. Examples of dusts which have the ability to penetrate the deep lung tissues and to be retained there are quartz, flint, chert, asbestos, talc, coal, iron, clay, slate, and other types of rock dust.

In order that the discussion may not go too far afield attention will be centered upon this last group and upon pneumoconiosis, the general term used to designate lung conditions caused by dust. Silicosis, which is caused by the inhalation of free silica, has been prominent recently in the public press, sometimes in a way that made misunderstanding possible, if not probable.

What Dusts Cause Injury?

It has been established that the potentiality of silicious dusts to cause lung damage is, with very few exceptions, dependent upon their content of free Silica (SiO_2). The development of silicosis depends, therefore, upon the concentration of dust containing free silica in the air breathed. In other words, the total amount of free silica breathed and retained seems to be the primary factor; the length of time necessary for a sufficient accumulation is important, but less so than the total load.

Silica occurs also in chemical combination in silicates. Some of these compounds have been proved definitely to be relatively harmless to health, some are still in the realm of doubt, and one, asbestos, may cause the disease called asbestosis, which is the result of lung damage similar to, but not identical with nor as serious as, that produced by free silica.

The size of dust particles in the air which an individual may breathe is important. Not often are particles larger than 10 or 12 microns found in the deep lungs, except in the case of asbestos dust, where fibres as long as 200 microns have worked their way down lengthwise.

Uncomplicated Silicosis. Silicosis, uncomplicated by an infection, is more of an impairment than a disability. It is not seriously disabling until it reaches an advanced stage, and does not of itself greatly shorten the life of a silicotic. It is in cases where tuberculosis develops that the worker must be removed from his occupation.

Silico-Tuberculosis. When a silicotic dies, the immediate cause of death is usually some type of intervening lung infection, as tuberculosis. It is not known just why the presence of silica in the lungs increases susceptibility to tuberculosis, but when an adult with silicosis is exposed to tuberculosis, an active infection may occur, regardless of the previous state of health. It is thought probable that silica dust can reactivate healed tuberculosis lung lesions of the adult type; how long after such lesions have healed the reactivation is possible is not certain. Exposure of silicotics to tuberculosis or of tuberculous individuals to silica dust is serious and should be avoided.

After silicosis has become well established in the lungs, medical science has not found a way to arrest the progress of the silicotic process toward the stage of disablement except through limiting or preventing further exposure to silica dust. Nor has medical science found a way to prevent tuberculosis from being superimposed upon silicosis, except through control of contact. The course of silico-tuberculosis is chronic and is very difficult to influence by treatment according to phthisiologists.

Medical Control

As a basis for intelligent determination of the physical fitness of a man for a job in a dusty trade, physical examination, with stereoscopic roentgenograms of the chest, is necessary. Along with this study goes, naturally, the preparation of an occupational history with detail as to the exact nature of previous work and of exposure to industrial dust —not a valueless recording of occupations as "laborer," "machinist," etc. Dr. Sayers of the U. S. Public Health Service, has developed a method of securing information for a proper occupational history; among others, Cummings, of Saranac Laboratory, also has worked out a useful history blank.

Standards have been developed for the diagnosis of silicosis. There is also a suitable technic for taking roentgenograms of the chest in order to bring out the characteristic lung changes.

Periodic physical examinations, including roentgenograms, are essential if employers are to be enabled accurately to learn the effect of individual exposure and intelligently to transfer affected workmen to lower dust concentrations before serious injury has been done, or to work out a system of rotation where indicated as desirable in order that ex-

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posure may be intermittent. Such examinations are helpful also in showing the efficiency of engineering control methods.

The ability to place responsibility in case of claim for injury is no small part of the value of such initial and periodic examinations.

Asbestosis. Clinical experience has shown that the inhalation of a sufficient amount of asbestos dust causes a serious type of fibrosis, which is not accompanied by an unduly high incidence of tuberculosis.

Other dusts and silicate compounds so far studied produce, at most, only a mild non-progressive reaction in the lungs, provided there is no significant amount of free silica in their composition. While not serious clinically, such conditions may give rise to considerable litigation.

Adequate statistics on morbidity and mortality from occupational disease, to serve as a basis for effectively focussing the efforts to study and control dust diseases of the lungs are non-existent.

Preventive Engineering

It would be needless repetition to attempt to discuss in a technical way the engineering phases of dust control. All interested are referred to *Industrial Dust*, by Drinker and Hatch, issued in August of this year, which deals comprehensively with the subject; U. S. Bureau of Mines Information Circulars 6840 and 6848, by Harrington and Davenport, a review of literature on *Prevention of Dust Diseases;* U. S. Public Health Service Bulletin 217, by Bloomfield and DallaValle, on *The Determination and Control of Industrial Dust;* Report 29 of the American Standards Association; and to the U. S. Bureau of Mines for a list of approved protective devices.

It may be said that, in general, the engineering specialist can and will devise the necessary equipment to meet the conditions specified to him. But the setting of limits of permissible dust concentration is not his but the physician's responsibility. The engineer is concerned with keeping dustiness to or below the limits at present considered satisfactory.

Methods of Determining Dust

Some dusts (as lead) are determined by chemical methods and the concentrations in air are recorded gravimetrically as milligrams per cubic meter. Others (as silica, where size is a factor in determining dangerous particles), are given by count. Neither method gives the whole story, but in both cases it may be possible to secure the information necessary for the purpose.

In one report this statement occurs: "There is no doubt in the mind of anyone familiar with the present dust-sampling and dust-estimating methods that they will be amended and changed from time to time. At the present writing we would advise the use of the simplest possible procedures where dust control alone is in question. If one wishes to obtain values which can be compared with published data, it is generally necessary to copy with considerable care the technic used in the original case. This is another way of admitting the annoying fact that results by one method are usually not comparable to those obtained by another method."

In another place, the report says: "It is very doubtful if any useful purpose is served by determining accurately extremely dense dust concentrations—the only excuse for such data is to show the skeptic that the workplace is much dustier than it should be . . . . .

"It is probable that any sampling procedure which fixes concentrations in groups 100 per cent apart is sufficient and that the results of any attempts to come closer to the concentration at the moment of sampling are simply misleading. Thus ranges such as 0-5, 5-10, 10-20, 20-40, etc., suffice for dust control."

Particle Size. As dust particles in the lungs are of the order of 1 micron, with rarely a particle over 10 microns, dust control for hygienic reasons should be aimed at particles in the size range found to have been breathed and retained. Again quoting: " . . . . . if one could avoid use of the dusts of 1 micron or less or exclude them from the dust which passes a 325-mesh screen, nearly all dust diseases would be eliminated." But to avoid the use of or to exclude these dusts involves very practical limitations. The thought here is to stress the desirability of study and experimentation in the direction indicated by the committee making the report.

Dust Elimination

Obviously, it is better, when possible, to purchase equipment already supplied with exhaust hood, rather than to have to worry to fit one to equipment not designed to be hooded. Thus the responsibility for potential efficiency is upon the manufacturer.

There is available comparatively little information upon which to base the scientific design of hoods. The Preventive Engineering Committee of Air Hygiene Foundation includes in its recent report a table of minimum air velocities to capture certain industrial dusts (for use in granite cutting, grain elevators, paint spraying, sand pulverizing, electric welding, electric plating, quarrying and mining, and hatters' fur.)

For protective equipment such as dust respirators, air supplied masks, sand blast helmets, and goggles, very complete information is available, because of the work of the U. S. Bureau of Mines, the Bureau of Standards, and the American Standards Association in preparing and issuing specifications to be met if the equipment is to be used under conditions where approval is necessary.

Of course, all agree that, where possible, dust should be controlled at the source, and protective equipment used where this action cannot be accomplished.

Permissible Dustiness

There are various figures that have been and are being used as guides to permissible dustiness where free silica is present. It should be noted that many of the data were not determined as the medical requirement, but as being attainable in good practice and apparently satisfactory from a safety standpoint.

In South Africa the figure is 1 milligram per cubic meter (or 300 particles per cubic centimeter, or approximately 8.5 million per cubic foot).

Dr. Lanza found in 1917 in the Joplin, Mo., district that, with good engi-

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