On the Effects of Exposure to the Dust of Eagle-Picher Insulating Material

by

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The actual methods employed in insulating homes with the type of rock-wool manufactured by the Eagle-Picher Lead Company were observed by visiting several sites at which this work was in progress. Thus the varying dust exposure associated with different operations and the precautions taken against such exposure were seen. The magnitude of the exposure to dusts in the various operations of a job in Cincinnati was determined by collecting samples of air in the immediate vicinity of workmen, under varying conditions, and estimating the quantity of suspended dust.

The lead content of a sample of the insulating material was determined by spectrographic analysis in order to make some estimate of the significance of the lead exposure of the workmen.

In order to observe the effects of human exposure to the dusts of the insulating material, a group of men were selected for examination and study from a large group engaged in insulating buildings. The selection was made in relation to the length of employment of men grouped in working crews in various parts of the country. From the available information, as shown in Table 1, it was apparent that the group in East Orange, New Jersey, had been employed longest, while the largest group in any one location, and, therefore, the one most readily

accessible, was situated at White Plains, Connecticut. These two groups combined could be expected to provide variability of exposure including the greatest which had occurred, and since none of those who had been in these groups had discontinued the work, there had been no factor of selective elimination. The Albany crew happened to be employed temporarily in White Plains at the time of the examination of the White Plains group. Their inclusion brought the total number of men examined up to twenty-seven.

Methods.

Dust samples were collected in the attic of a house in process of being insulated, in relation to both hand-packing and blowing. Samples were also collected at the air pump used to blow the insulation. The modified Greenburg-Smith impinger was employed with the standard hand-driven suction apparatus. The technique of collection, handling and counting was similar to that described by Bloomfield and Dallavalle (1).

The complete history of all previous and present employment and of previous illness was recorded for each man, together with his age, his family history, the general state of his health, and the presence or absence of symptoms of illness or organic disease. Special attention was given to the duration of the present employment and the nature of the day's work, with reference to exposure to dusts of insulating material. A complete physical examination was given each man, including tests of the special senses and of muscular power, analysis of the urine for its reaction and for albumin and sugar, and a microscopic study of the blood. That is to say, a thorough search was made for any and all physical ailments or abnormalities. These observations were recorded on the forms reproduced in Figures 1 and 2.

A sample of blood and two samples of urine were obtained

from each man, in chemically clean containers prepared in the laboratory. These were returned to the laboratory for analysis. The blood and one of the urine samples were examined for lead by a sensitive and accurate spectrographic method which has been described elsewhere (2); the other urine sample was examined for arsenic by the Gutzeit method.

The chest of each man was further examined by means of stereoscopic X-ray photographs taken and interpreted by an experienced radiologist. Another competent radiologist studied all the plates and independently gave his opinion as to their significance.

Results and Discussion.

The results obtained in the dust counts are shown in Table 2.

Considering the physical character of the dust particles most of which were hair-like and therefore would tend to be entrapped in the upper respiratory tract somewhat more readily than natural rock dusts, it is probable that the effects of exposure would be less severe than those produced by similar material of more common structure.

In view of the chemical composition of the material one must consider the effects of silica and of certain heavy metals. It is generally believed that the characteristic lesions of silicosis develop either very slowly or not at all when there are fewer than 5,000,000 particles of pure silica per cu. ft. as determined by a light field method of counting comparable to that employed here (3). It would seem, therefore, that the development of silicosis need not be expected in relation to the hand-packing operations, regardless of the form in which the silica may appear in the rock-wool. The hazard of the blowing operation, on the other hand, would depend in part upon the degree of protection provided by the use of masks, and in part upon the proportion of toxic silica in the material. One is justified in the feeling that silicosis might well develop among

men employed in blowing operations unless due precautions were taken.

The danger of heavy metal poisoning would be great at these dust concentrations, if there were significant quantities of such metals in a soluble state in the material. Even relatively insoluble compounds of lead, for example, would be potentially dangerous. Here, however, we are dealing in some measure with hypothetical matters, such as the proportion of material actually inhaled as compared with that swallowed, as well as its solubility and absorbability in the lungs and in the alimentary tract. It seemed best to deal with these matters practically through the study of the exposed men rather than by methods based on hypotheses. However, the total lead content of two samples of the rock-wool was determined by analysis. A sample of material such as is put through the blower showed a lead content of 1.12%, while a sample of that packed by hand was 0.96% lead. Arsenic determinations were not made because of technical difficulties due to the nature of the material. (The exact composition of the rock-wool will be determined at a later date. The spectrograms which were taken to measure lead quantitatively demonstrated the presence of large quantities of iron, appreciable quantities of aluminium and manganese, together with traces of copper, chromium, nickel and tin.

The information obtained from the examination of each man was considered first as a unit. In no case was there clinical evidence of any occupational illness or disease. No man was ill or complaining vaguely of generally poor health. No man had lost weight, appetite or strength, nor was there any combination of symptoms or physical signs suggestive of silicosis, or of lead or arsenic poisoning. The only common abnormalities involved the teeth and gums and the upper respiratory tract. Several men had common colds in various stages, and most of them showed some degree of redness and irritation of the mucous membranes of

the nose and throat. Only a few had good teeth and clean healthy gums. However, despite the frequency of dental caries and spongy, congestive, gingivitis, no lead line was observed. (The occurrence of gingivitis and dental caries is so common among working men in general as to have no specific significance.)

In the absence of individual cases of occupational illness among the men, further study was made of the group as a whole in search of less definite deviations from the normal which might indicate the existence of some common factor or factors of an injurious type. The more significant results of such study are set down in tabular form. Table 3 gives the age distribution of the group, and shows that the men under study represent a rather wide range with respect to their age. In Tables 4 and 5, the variation in systolic and diastolic blood pressure of the group is shown. (The circulatory system shows evidence of impairment or abnormal function in most cases of chronic or sub-acute intoxication, and for that reason any unusual trends in blood pressure are of importance in group studies of toxic agents.) Of the five instances of significantly high systolic blood pressure, four were in persons over forty years of age. The one rather low figure (100) occurred in an otherwise apparently strong and healthy man. The one definitely abnormal diastolic pressure (105) was found in a man of 44. The occurrence of high blood pressure among persons in the middle and later decades in all walks of life is too common to require further comment. Suffice it to say that the data on these men are not unusual for groups of corresponding age in any occupation.

Table 6 groups the data on the leucocytes (white cells) of the blood. There are no abnormally low results. Six results showing 10,000 leucocytes or more per cubic millimeter of blood were found in persons who had evidences of active or subsiding upper respiratory infections without

disability, or other evidence of infection in the form of suppurative gingivitis.

Tables 7, 8, and 9, give the results of the study of the erythrocytes (red blood corpuscles) of the blood. Inasmuch as lead absorption tends to cause an increase in the number of "stippled" erythrocytes, and a later decrease in the total number of erythrocytes, together with a drop in the hemoglobin of the blood, these observations have a direct bearing on the questions of lead absorption in these men. The one low erythrocyte count of 3,400,000, was not accompanied by other evidences of abnormality, the hemoglobin value in this case being well within normal limits. The result is not of physiological significance, therefore. All the hemoglobin determinations (Dare instrument) gave results within the normal range. The study of the stippling of the erythrocytes, likewise yielded normal results. Observations among large numbers of apparently normal persons outside the lead trades, made by the methods used in this study, have been reported elsewhere (4) and provide a basis for the interpretation of these findings. The one result of 40 stippled erythrocytes per 50 microscopic fields is unusual, but such values occur in entirely normal and healthy persons. All the other results are well within the customary normal limits. The analytical results obtained on the blood and urine are recorded in Tables 10,11 and 12. The quantities of lead found in the blood of these men cover a range of variability such as has been reported previously in a group of normal healthy students (5). There is no abnormal result in the entire group. The analyses of the urine for lead also yielded results within the normal range as previously determined for large groups of normal persons (5)(6). It is quite certain, therefore, that the inhalation of the dust of the mineral-wool has not resulted in an appreciable lead absorption on the part of these men. The arsenic determinations on the urine are subject to

similar interpretation. The range of normal values for urinary arsenic is not as well established as in the case of lead, but the mean excretion of a limited number of normal persons whom we have studied corresponds to that obtained in this group of men. The six relatively high results (i.e. 0.06 mgs. of As_2O_3 or more per liter of urine) show no correlation with the higher lead findings, or with the duration or apparent severity of the occupational exposure. They may be regarded as random results unrelated to the occupation.

The examination of the X-ray films by the three radiologists resulted in the general agreement that there were no demonstrable pathologic processes or deposits which could certainly be attributed to occupational exposure to dusts. In several cases there was a distribution of fibrous changes suggestive of incipient silicosis but of such minor character as not to be certainly differentiated from the secondary effects of chronic or subacute upper respiratory infection. One of the radiologic consultants expressed their joint opinion, that the "lesions are more numerous in this group of men than one ordinarily sees in a similar number of adult chest films. However, there being a small group who have none - - - to speak of, one must wonder whether or not the findings are of significance. I do not see how one can be sure - - - until a considerable time interval has elapsed and another series of films (has been) made on the same group of men, - - - - I concur in the conclusion that nothing has been found which can be attributed to the industrial factors involved. "

Summary.

1. The methods used in insulating buildings with Eagle-Picher rock-wool involve considerable exposure to dusts rising from the material. The hand packing operation was seen to result in suspending somewhat less than 500,000 dust particles per cubic foot into the air; in the immediate vicinity of the operating pump, the particles numbered approximately 750,000 per cubic foot; in the blowing operation the dust exposure was as

high as 8,000,000 particles per cubic foot.

2. The nature of the material is such as to suggest the possibility of a silicosis hazard. The lead content (approximately 1%) of the silicious material is of doubtful significance, theoretically. The arsenic content was not determined.

3. The study of 27 men of whom a number have had more than four years of exposure to dusts in handling the insulating material, failed to show any clinical evidence of occupational disease or illness.

4. Study of the lead and arsenic excretion of these men disclosed no evidence of absorption of lead or arsenic in quantities above that which has been shown to occur among normal persons without occupational exposure.

5. Radiographic chest examinations showed no certain evidence of occupational pulmonary disease such as occurs in severe exposure to silica. There was suggestive evidence of the development of pulmonary changes, but the evidence was not sufficiently convincing to justify a diagnosis of early silicosis in any case.

References.

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