

May 4, 1940

Dr. H. Heimann
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New York City
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Dear Doctor Heimann:

In reply to your questions concerning the safe limits for industrial lead exposure, I think it is only fair to say that the limits which are accepted as fairly adequate at present by a number of authorities are based on observations which have been made carefully. Any literature which is cited, however, must be related to the specific methods by which the information was obtained. Thus when Bloomfield and his associates in the Public Health Service mention the figure of 1.5 milligrams of particulate lead per 10 cubic meters of air as the safe limit for exposure by inhalation, they are referring to the application of the impinger method of collecting samples of air in industrial plants in areas which are free from lead intoxication among the workmen. The impinger method of sampling, obviously, does not collect all of the lead which is in the air. It misses some considerable proportion of the most finely divided particles, and it probably misses most, if not all, of the fume. Therefore if electro-static methods of collecting lead are employed, the results, generally speaking, will be somewhat higher than those obtained by the impinger method. Other methods will yield somewhat different results, and, so far as I know, there is no means of relating these results one to the other. I have no reason to doubt the essential correctness of the figures based on impinger observations. Indeed such correlative results as we have would seem to indicate that they are substantially correct.

Our own observations have been made not exclusively but largely on the basis of the studies of the rate of lead excretion of groups under variable conditions of exposure. After a good many observations on a rather large number and variety of industrial establishments, we have been able to correlate clinical observations with excretory studies in such a way as to define a critical level of lead excretion in relation to lead intoxication. A group of workmen whom we have followed

over a period of years show mean values of approximately one-tenth of a milligram of lead per liter with a range of variation extending from 0.06 to 0.15 milligrams per liter. Large numbers of individuals in groups below this level have failed to show lead intoxication, and a number of groups with excretory levels above this range have uniformly shown some occurrence of lead intoxication. In this particular group there has been no case of bona fide lead intoxication, but there have been suggestive clinical evidences of pro-dromal intoxication, especially as the result of some chance additional exposure above the toxic level. Having followed this group for many years, we feel quite certain on clinical grounds that they are right at the threshold of intoxication, although none of these men has had to discontinue his work on account of illness or suggestive symptoms.

In our opinion the level of lead excretion in the urine, and to a lesser extent the level of lead concentration in the blood, constitute the best methods of measuring the over-all lead exposure, and as the result of our experience, we believe it is possible to differentiate between safe and dangerous lead exposure on this basis more precisely than by any other method. It is generally believed, of course, that industrial lead exposure is chiefly a matter of inhalation. In this opinion I fully concur. On the other hand lead poisoning does occur as the result of lead ingestion, and in many occupations it is difficult, if not impossible, to exclude completely the factor of lead ingestion. We believe, therefore, that it is wise to take this matter into account and to study the lead excretion of representative workmen in a plant as a means of measuring the lead exposure. Nevertheless you will be interested in knowing that we have made air analyses in connection with some of our observations, and the threshold value given above for the lead excretion correlates quite closely with the accepted figure of 1.5 milligrams per 10 cubic meters of air. Actually our figures are a little higher than this (approximately two milligrams per 10 cubic meters), although there has been some variation which might indicate that the lower value is the more acceptable one. In our own study we are planning to make use of the electrostatic method for the collection of dust and we believe that safe limits will eventually be more accurately defined in terms of electro-static measurements plus determination of particulate size in a variety of industries.

Finally I would not want to leave this matter too much up in the air by my discussion. For practical purposes I am convinced that the reduction of occupational lead exposure to a point where workmen are exposed to lead in the air in concentrations not greater

than 1.5 milligrams per 10 cubic meters, would result in the virtual elimination of lead intoxication from American industry. If we were in position to accomplish this measure of control, we could then be quite content to investigate further and to introduce further refinements into our hygienic control. This degree of control is far from accomplishment, however, and perhaps one of the greatest needs in this field of work is to educate industrial management to the point where this degree of safety will be provided. I make mention of this only because one of the great obstacles to the accomplishment of this program is the uncertainty with reference to the adequacy of our present knowledge. Therefore I do not want to contribute to this state of uncertainty and thereby encourage delay in the application of present knowledge.

There is a further problem which does not relate so much to occupational lead exposure but which is a factor in occupational lead exposure, namely the limits of safe lead intake by ingestion. We are working in this field and have some very interesting observations to report. We have been following the total lead intake and output of human subjects who have been taking lead daily in known amounts in addition to that which is in their food, over a period of years. I shall not go into these results for I feel certain you are chiefly interested in the inhalation of lead. I merely mention the problem, however, since it can not be ignored entirely in industrial lead exposure.

I trust that what I have said will be of some use to you, and if I have aroused any further questions in your mind, I shall be glad to try to answer them further.

Very truly yours,

RAK:is

Robert A. Kehoe, M.D.