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July 25, 1956

Dr. Francis M. Pottenger, Jr.
609 North Canyon Boulevard
Monrovia, California

Dear Pottenger:

Thanks for the return of the letter sent to you by mistake, and also for your additional comments on the air pollution problem as it relates to lead.

I hope very much that you do come to see me in September when you are in this part of the country, for it would be much easier to show you some of the information on this subject as we have accumulated it, than it is to document it by published articles, or merely to state the facts. One has to obtain a quantitative grasp of the entire situation, with respect to the occurrence of lead in nature and also its distribution in the modern world, in order to have a balanced view of the problem. I hope you let me know when to expect you, so that I shall not be elsewhere, for I would like to plan so as not to miss you.

I should prefer to leave the entire matter to our future discussion, and I would do so but for the indication in the second paragraph of your letter that you have considered the exposure to exhausted lead in the atmosphere of Los Angeles to be capable of giving rise to overt clinical signs of lead absorption. I hesitate to let this pass without comment, for it is so far afield from the true situation as to demonstrate that you are not thinking in the right terms quantitatively. The best that one could hope to do, in undertaking to obtain some evidence of the absorption of lead from this specific source, would be to find a statistically significant difference in the analytical findings - blood or urine or both - in a group subjected to the most severe and most prolonged exposure of this type, as compared with a group or groups essentially free of such exposure or nearly so. It is this type of investigation that we have engaged in previously and are repeating now. It appears, from both direct and indirect evidence, that the lead in the general atmosphere of our cities contributes only something of the order of ten or fifteen micrograms (0.010 - 0.015 mg.) of lead per day to that which is absorbed daily from other sources, there being approximately three hundred to three hundred and fifty micrograms (0.30 - 0.35 mg.) of lead per day in our ordinary food (and beverages), of which something less than twenty per cent (20%) is absorbed under the most favorable conditions. At least half of the lead that is found in the American

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dietary is of natural origin, and a significant proportion, which is difficult to estimate for the lack of entirely valid control data, of that which is in the atmosphere, is also of essentially normal origin, in the sense of being derived from sources that are almost as old as the earth itself. Suffice it to say that the collection and analyses of samples of the particulate material in the atmosphere in widely separated areas of the North American continent have yielded lead in quantities of the same general (small) order of magnitude.

This then is a part of the background, and the situation that exists at present, with respect to the general exposure of our people to lead, differs only a little from that which has existed for a very long time. Indeed the contribution made by leaded gasoline, which must certainly be finite, has been difficult to separate out from the other factors. Only by means of a large number of analyses at strategic points, and after the application of statistical methods of differentiation of the results obtained at various carefully selected locations, have we been able to find fairly convincing evidence of the independent significance of this factor.

This leaves but one other point to be mentioned to substantiate my earlier statement that clinical signs of lead absorption from this source are not to be expected. We have been observing the clinical and physiological evidences of lead absorption experimentally and clinically for many years, as you know. The physiological responses of workmen and experimental subjects to the absorption of lead from the alimentary tract and from the respiratory apparatus have been measured by precise methods in a comprehensive manner. It will interest you to know that when the concentration of respirable and absorbable (particulate) lead in the atmosphere has been increased to ten times the peaks of lead concentration which we have found in Los Angeles and Pasadena during periods of severe inversion, so that the air in a respiratory chamber contains 0.15 mg. per cubic meter, the concentration of lead in the blood of experimental subjects, after 18 to 24 months of exposure for 7.5 hours per day on 5 days per week, increases to only 0.045 mg. per 100 grams. The urinary lead concentration increases somewhat more proportionately. Under these circumstances no increase in stippling is seen, and no lead line of the gums develops.

With these facts in mind, one may not expect the absorption of lead which results from the ingestion of lead in food and drink and from the atmosphere of our cities to show more than a minute effect of a physiological type, if any. The occurrence of physical signs of lead absorption under these circumstances is really out of the question. A lead-line in the gums can occur rarely (I have seen it once) when the blood level is around 0.05 mg. per 100 grams, but it is associated generally with much higher blood levels. Stippling, I need not remind you, I am sure, occurs normally in blood, is augmented by a great variety of stimuli to the bone marrow, and even when it occurs as a response to lead absorption, it exhibits no quantitative correlation with the extent of the absorption.

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I do not resort here to criticism, for it is necessary to look with minute care for anything one can find. Actually, in the course of our work, we have applied every clinical and physiological tool that is known and some that were invented for the purpose. Indeed, it is for that reason that I know what to expect in relation to various levels of lead absorption.

I did not intend to write so long a letter when I started, for I have many things knocking at my door to be done. However, having started, I was drawn into the long and wide stream of evidence, some of which I hope to have the means of showing you before long.

Sincerely yours,

Robert A. Kehoe, M.D.

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