

July 12, 1968

Douglas L. Worf, Ph.D.
Office of Research and Development
U. S. Public Health Service
Department of Health, Education and Welfare
Washington, D.C.

Dear Doctor Worf:

I have reviewed the document which you left me, and a few comments on it seem to me to be indicated. I have not gone into the details, however, and if what I say herein should raise questions in your mind or call for documentation, I shall be glad to respond accordingly.

I think I should make one additional comment. My associates and I have been gathering information on this subject for some forty years. Much of what we have done relates directly to occupational problems, but many aspects of the general environmental situation with respect to lead have been touched upon or investigated in some depth. It has not been possible for me to publish all or even the bulk of the physiological and medical information so acquired, during the active years of my headship of this Department and Laboratory. I am now engaged, or I should say, preparing to engage, in assembling, appraising, and preparing this information for publication. This will take time and hard work, but I hope to get the useful data into print. Some of the needs set forth in page 2 of your memorandum fall into line with these efforts. I believe, for example, that we shall be able to set up an equation whereby the approximate body burden of an intact man can be calculated from certain analytical findings plus a reasonably satisfactory history of his experience. I think we have adequate data on all of the parameters that enter into the formulation of such an equation, and it will turn out to be fairly simple to arrive at values that will come very close to the truth. A beginning was made by my former associate, Theodor Sterling, but I could not find the time to work with him on the physiological factors involved, as I interpreted them.

There are other aspects of the entire problem that can be solved fairly effectively by the detailed examination of available data. So much for page 2.

In your skeleton discussion on page 3, certain statements require amplification. I shall not attempt to provide this, but I shall comment on some points which I believe to be either false or misleading. As to the need for amplification, I consider that the listing of the clinical manifestations of lead poisoning is unsatisfactory, both as to the matters included and the matters omitted. The "understanding of the effects of high dosages of lead" is not well known. Few physicians have any real understanding of the matter, while, none except physicians have anything approaching understanding. This is one of the real difficulties of the situation. Because lead poisoning has occurred for centuries and is mentioned in virtually every text book on medicine, it is assumed that all doctors know much about lead poisoning. The average physician in our day has never seen or handled a case of lead poisoning. You should know what happens in the courts and compensation agencies of the land, when controversies arise simply because a practicing physician has encountered this disease for the first time,

and has no idea what to do about it. The reason for this lies in the fact that the cases are mostly industrial and that these are handled by industrial physicians, simply because of the organization of our society.

There are other statements that are altogether too meager in scope to carry their weight, but I shall not go further at this time. One statement in the fifth paragraph on page 3, however, must be singled out for criticism. It is said that "25 to 50 percent of the respiratory intake may be retained and absorbed." I have not equated "retention" with "absorption," for the reason that this cannot be done on present information. Such "evidence" as is available indicates - or at least, suggests - that as little as 10 percent of the lead retained in the lungs is absorbed within the lung. It is quite certain, from our present respiratory experiments, that it is much less than 25 to 50 percent, but it is not possible from our experiments to calculate the amount absorbed. We hope to be able to carry out experiments to establish the extent of the clearance of specific preparations of particulate lead from the lung and from the body. If we can do this, we can make a series of calculations in connection with some twenty-odd experiments that have been carried out since 1940, that will serve to answer a lot of questions.

Incidentally, it is this very matter which has been responsible for our controversy with John Goldsmith over the significance of lead in the ambient air. He insists on his interpretation of certain of our data, which are not susceptible, at present, of quantitative assessment. The evidence for the greater significance of the absorption of lead from the alimentary tract than from the respiratory tract of our experimental subjects under normal (control) conditions is overwhelming, but the data have to be examined carefully and in detail, in the absence of conventional assumptions, in order to appreciate this fact. No such experiments have ever been carried out before, and so a number of fallacies in our previous ideas have been revealed. Indeed, it is precisely because many of the earlier concepts appeared to be poorly based on reliable data that we undertook these troublesome pedestrian and costly experiments, beginning (as to those concerned with the absorption of abnormal amounts of lead from the alimentary tract) in 1939.

Only two other flat statements, both occurring in the Summary (page 5) call for equally flat contradictions.

1. It is said that:- "Lead as an environmental pollutant /whether of the air and water, or of the food and other beverages (my parenthesis)/ is only 40 years old and is rapidly increasing." The fact is that there is no ground for any part of this statement. Certainly lead was discharged from the tail-pipe of an automobile for the first time in 1923, but lead has been dispersed into the air from a variety of other sources for a very long time, and even now, in certain localities, more is emitted into the air from certain industrial stacks than from automobiles. There are other sources of long persistence, but I shall not labor the point. You will say that your statement is approximately correct quantitatively, and therefore is not entirely false, but I must insist that this even in the quantitative sense, is pure assumption. The behavior in the air of the lead from the exhausts of automobiles is such that no rough assumptions dare be made. There is suggestive evidence that its dissipation in the atmosphere and its eventual deposition in the seas are of such character as to have brought about, or are near to bringing about, an approximate equilibrium, so far as the lower layers of the atmosphere are concerned. Do not interpret these statements as representing facts. All I am saying is that the simple facts are such that they may well be true, for aught you or I know. I have

good reason to be skeptical in this matter, for I have had to alter my views in recognition of cold facts on several occasions. I am cautious in my appraisal of the meaning of certain unexpected facts, such as, for example, the incontrovertible evidence that the lead in the air of Cincinnati, on an over all geographic basis, has been decreasing since the middle forties. I think we know something of why this has occurred, but it is not all that clear.

The other statement to which I must take exception is that:- "Lead accumulates in man with age." This may be true, but there are very good reasons, supported by sound data, to indicate that it is not true under the conditions of exposure to lead as it occurs in the general environment. There is no doubt that when the intake of lead into the body reaches a certain sustained level, as in our experiments, or in industrial exposure of certain types and at certain levels of dosage, progressive accumulation occurs in the body. I can give you chapter and verse, in the form of sound data, to prove these statements. Others have stated what you have restated, but none of them have taken the trouble to sort out of the population under investigation those persons who have been subjected to exposure to lead well beyond that represented by strictly general environmental conditions. Lead accumulates in man, for long or short periods, whenever the persistent intake exceeds the physiological capacity of the body to eliminate it. Within the limits of the day-to-day exposure to lead of normal healthy persons in Cincinnati, our balance experiments alone indicate clearly (without the absolute proof that could be obtained by post-mortem analyses of tissues) that any accumulation that occurs in the bodies of our subjects in either nil or is so small as to be insignificant in a life-time. Analyses of selected cadavers (too few to provide proof but too numerous to be ignored) tend to confirm this view. The evidence is that the new-born child of "normal" (in the sense of our discussion) parents contains very little lead, but that by the time he is 3 to 6 years of age (and is subsisting on a mixed (rather than a milk diet which is very low in lead), he has acquired a quantity of lead in his body which increases with growth without altering appreciably the concentration of lead in the tissue. He is, in other words, in equilibrium with his environment as to his general intake and output of lead. From that point on, the body burden of adults of the "normal" type varies with the general level of their intake of lead, which varies with their size, physical effort, and dietary choices. Some through choice, take a relatively high lead-containing diet throughout most of their lives. They wind up with a body burden as high, perhaps, as 400 milligrams of lead, most of which is dispersed in 12 to 15 kilograms of skeleton (mostly mineral). Its highest concentration is of the order of about 40 parts of lead per million parts of bone. The Peruvian skeletons have been said to contain up to 110 parts of lead per million parts of bone. Some eat lightly of a low lead diet, and have a body burden of, say, 100 milligrams. Many women and many other persons in low economic circumstances (poor to moderate nutrition) fall within this category.

Now what I have said above has not been proved beyond doubt, but it appears, on reasonably good evidence, to be true - in fact, on much better evidence than that which documents our current views of most of the other mineral elements. You will appreciate, therefore, why I object to statements that fly in the face of such evidence. People who have fragmentary evidence are prone to interpret it decisively, while those who have more comprehensive evidence have questions in proportion, and tend to be modest in their representation of facts.

I have gone to considerable length in conveying my viewpoints, simply because I sensed in you a willingness to be objectively critical. I would like to see this

problem, and kindred problems of environmental health, settled on evidence. I recognize the position (and the accompanying pressures) of persons responsible for the health of the public, but I do not assess the responsibilities of the physician investigator as being one whit less binding.

It was a pleasure to see you and your associate, and I hope you will come again.

Cordially yours,

Robert A. Kehoe, M.D.
Professor Emeritus of
Occupational Medicine

RAK:wp

P.S. My secretary will reproduce the two bulletins which I showed you, when she can find the time to do so. You may expect their delivery within a reasonable period of time. It would be well if you were to send me your official title and address, so that these photocopies will not go astray.

RAK