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Dear Doctor Tipton:

I am glad to have received your revised paper on "Patterns of Elemental Excretion in Long Term Balance Studies," and I'll examine it carefully just as soon as I am able to clear my desk of matters accumulated during my vacation. At that time, I may have some comments to make to you. Needless to say, I am pleased by the use you have made of the materials with which we have supplied you. I am moving toward the presentation of the full data of these and other experiments on the metabolism of lead in a monograph as soon as I can free myself of certain other activities which have continued to be deposited on my doorstep.

I think I should make some mention to you (for our mutual understanding) of some matters which have arisen out of your long-term investigation of the occurrence and distribution of lead in the human body. I have been aware for some time of the work of Henry Schroeder, of his views of the significance of the data which you and your associates have gathered, and of a certain hostility - this may not be the correct word to describe his attitude, but it appears to me to fit the case - toward some conclusions at which I have arrived concerning the behavior of lead in the human body. I shall take these matters up with him directly at the proper time, for there is little place for personal animosities or suspicions among honest investigators. However, since your data, and perhaps some comments attributed to you, are involved, it seems appropriate to acquaint you with the issues as I view them.

First is the question of the accumulation of lead in the human body in relation to age, under conditions that relate to the occurrence of lead in the general human environment. In order to establish the facts in this regard (as well as in certain other relationships), we have followed the metabolism of lead in human subjects (as you well know), and have analysed the tissues of certain individuals whose intake of lead was found to be limited to ordinary environmental conditions to the exclusion, on reasonable grounds, of "abnormal" types of exposure (occupational, unusual environmental conditions of known significance in relation to water supplies, regional factors, etc.). It is entirely clear, as we have shown (under conditions of exposure of mild to moderate severity) that lead ingested or inhaled continuously above certain levels of intake) induces various rates of accumulation in the body, dependent upon the continuous rate of absorption. It appears that this rate of accumulation is steady for as long as the exposure continues and is constant rather than intermittent. Intermittency, as in occupational exposure, results in the establishment of an equilibrium between intake and output, that is, in a steady state which remains steady so long as the type and degree of exposure remains unchanged. On the other hand, the body is able to maintain a steady state, or a state so nearly steady, as to result in no measureable accumulation during a lifetime, so long as the current level of the environmental exposure to lead remains of the order of magnitude that has persisted during the past thirty years or more.

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This is what our data indicate, and I have been unable to find evidence (including yours) to indicate otherwise. The flaw in several published collections of data, is that the findings in the tissues of certain deceased individuals are in excess of those that appear to be uncomplicated by unusual types of exposure to lead during life. I found Tompsett's* data out of line (for example), called his attention to the high values, and received from him a complete and satisfactory acknowledgment of the fact that his cadavers came, to a significant extent, from an area in Glasgow in which the drinking water contained dangerous concentrations of lead, because of an old but persistent custom of collecting water from the rooves in lead-lined tanks in the attic. Cases of plumbism had been occurring from time to time for more than a century.

The fact is that unless one knows a great deal about the environmental conditions and the habits of life and employment of the deceased persons, it is impossible to exclude significant variables from the case material. This fact does not detract greatly from the importance of your data, but it does, I believe, make them unsuitable as a measurement of the effects of the usual or general environment with respect to lead. From the general practical viewpoint, these data represent human experience on a broad base, but they do not serve at all to indicate the significance of lead in the air (of American cities) as a feature of present day conditions. The issue here relates, principally, to the significance of lead in the air as a problem of public health in the United States (and to a lesser degree, elsewhere). I've been trying to measure this for the purpose of proposing a standard for safety. The assumption of Schroeder (and, more particularly /since Schroeder knows very little about me and my purposes/, certain other persons who should know better) is that I am undertaking at all costs to defend the lead antiknock industry. The fact is that Ethyl Corporation, along with some other involved industrial organizations, have supported the work of the Kettering Laboratory as I have programmed it in this area, for nearly forty years, in the full understanding that it was essential to their own policy to know the whole truth. This has enabled me to carry out such physiological investigations as I have thought necessary, regardless of their cost and of the nature of the results. (I hardly think it necessary for me to discuss this with you, but I do so for the sake of completeness.)

Now as to the lead in the air, there is a wealth of evidence to indicate that it has been physiologically and hygienically insignificant up to the present. Indirect evidence indicates that not more than 10 to 15 percent of it is actually absorbed in the pulmonary system. This may or may not be true, quantitatively, but certainly a sizeable portion of that retained (in our experiments) in the lung is cleared from the lung rather than absorbed therein. We are undertaking to determine the extent and the route of this clearance, and we shall not know about these things in a definitive manner until this has been done. In any case, however, the evidence is that the lead absorbed from the alimentary tract is a much larger factor than that absorbed from the lung. Further, the evidence is strong indeed, that the combined absorption from the respiratory and alimentary tracts are being handled satisfactorily by the normal human body. Meanwhile, the assumptions made in this area of public health enable some otherwise responsible persons to maintain apprehension among many people, including some in the Congress, that the public danger from environmental lead, especially that in the general ambient air, is growing and nearing the point of general significance.

I failed to point out above, that our data on selected cadavers (bodies of persons in the general population) are insufficient to prove my point as to the lack of accumulation of lead in the body with age, under prevalent, general conditions. We are attempting to mend this, but I am sure that you will recognize the difficulties

* Tompsett, S.L.: Biochem. J. 30:345-6, 1936.

of learning, after the fact, the total relevant history of deceased persons. My working relationship with the Coroner of Hamilton County (the morgue and the Coroner's facilities are housed in the Kettering Laboratory) enables us to obtain the histories of well-known persons (rather than the totally obscure persons in the charity wards of the Cincinnati General Hospital), who die as the result of violence and come to the attention of the Coroner in the course of the legal requirements. Such evidence as we have, however, supports, without exception, the view which I expressed above.

You may be surprised and, perhaps, discommoded by the contents and length of this letter, but because of our collaboration with you in supplying some material, I have thought that you deserve a frank presentation of some relevant facts and views.

With kindest regards,

Sincerely yours,

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

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