January 25, 1968

Dr. Henry L. Fisher
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Dear Doctor Fisher:

I am grateful to you for sending me a copy of Part I of your report entitled "Estimation of Exposure to Radon Daughter Products by Measurement of the Lead-210 Body Burden." I have found this extremely interesting in view of our own present efforts to obtain valid information on the relationships which obtain between various types, intensities and durations of exposure to lead. I wonder if I might not suggest that it might well be desirable, from your own viewpoint, to send a copy of this report to Dr. Theodor Sterling (whose address appears below) who worked with us for quite some time before he went to St. Louis, and whom I expect to examine our data further, when suitable arrangements have been made for so doing. I would be very much interested in his comments in an area in which I have no proficiency, and perhaps you would find this useful.

As for my comments, which because of my mathematical limitations, cannot be regarded as an effective critique, I wish merely to refer briefly to three matters, while making a general statement. For the latter, let me say that I do not find any essential conflict in your approaches or interpretations of certain available data, with physiological facts and concepts. Incidentally, I am pleased that our data have found a useful place in your consideration of the facts in human experience. As to the three points, referred to above, I shall consider them separately.

First, as to the influence of the skeleton on the biological half life of the body burden, it need not surprise you that this aspect of the situation is highly variable. There is the factor, of course, of individual variability, which is considerable, and does not, at present, lend itself to any very precise interpretatio There are, however, several physiological factors that can be expected to exert important influences (and there are others, doubtless, of which we have little knowledge). (1) The distribution of body burden of lead, as between the soft and hard (skeletal) tissues varies with certain unknown (presumably chemical) factors which influence the relatively loose binding of lead in these tissues. The liver and kidneys, as well as the somatic musculature are especially important, in all probability, in this regard. This variability contributes, no doubt, to the variability in the rate of the intake, deposition and discharge of lead from these tissues. (2) The skeleton is highly inhomogenious in its circulation and in its internal metabolism. Thus, lead which is introduced into the skeleton appears first (as part of the chemical composition) in the vascular rapidly metabolizing portion, but moves thence into the more distant, less vascular and more slowly metabolizing portions of the skeleton. The dense bone of the shafts of the long bones, an ivory-like structure, takes in lead very slowly and gives it up at a

comparably low rate. Thus, the time factor in the achievement of the body burden - i.e., brief versus prolonged exposure - is a prime factor in the biological half life of lead in the human body. You may have noted this in the data (and figures) in the Harben Lectures, in the rate of loss of lead from the bodies of the subjects of the long and shorter term experiments on the ingestion (i.e., oral intake) of lead. We hope to be able to obtain some mathematical expression of this factor to apply in practice.

Another highly important feature of the behavior of air-borne, inhaled lead compounds has to do with the physical and chemical characteristics of the material inhaled. You have observed certain differences in the retention of lead in the respiratory tracts (lungs) of animals in different groups, as for example those subjected to radon in chamber experiments and in mines, and have mentioned certain differences in the results, as for example the occurrence of dust in the mines. This factor alone could result in gross differences in the pulmonary retention, since the radon may well have been adsorbed or combined otherwise with relatively inert particulate material, and remain in the pulmonary tissue for a long time.

There is much in the physiology of the clearance of particulate matter from the lungs that is unknown at present. Certainly the temporal and quantitative relationships are highly uncertain. On the other hand, the size of the particles, their solubility in the pulmonary media, and their capacity to induce local injurious effects are known to be factors in their fate. It is believed that even under favorable conditions for absorption, a considerable portion of that which is retained during inhalation (apart from that which is exhaled), is moved upward into the upper respiratory tract, whence it gains entrance to the alimentary tract. No one knows the extent to which this occurs in a variety of conditions relating to particulate size and rate of pulmonary absorption, or as to the time factor involved in the clearance. Thus, the opinions of various persons, as expressed in the literature, concerning the quantitative relationships involved in the quantities of lead absorbed in the lung from the ambient air of our cities at the present time range from 10 to 50 percent. Actually no one knows, but the indirect evidence indicates that it is nearer the 10 than the 50 percent. Incidentally, we have an experimental approach in mind, by which this can be determined, and we hope to put this approach to the test before long.

But, while the absorption of radon gas should be a simple expression of the gas laws under ideal conditions, it is likely to be very much affected by the presence of particulate material of various types and dimensions in the air breathed.

I am delighted that various investigators possessed of varying types of technical knowledge and methodology are attacking this important physiological problem, and I hope soon to see the development of information that will substitute facts for some of the fancies that are being taken too seriously.

Sincerely yours,

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