

November 1, 1967

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Editor of Science
American Associates for the
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Dear Doctor Abelson:

I have thought it advisable to criticize a recent article in "Science," and would appreciate very much your good offices in bringing my comments to the attention of your readers.

In an article which appeared in Science, as of October 6, 1967, p. 132, on "Respiratory Exposure to Lead", Goldsmith and Hunter cited certain data from a report from the Kettering Laboratory /Proc. XV Congr. Intern. Med. Travail., Vienna 3,83 (1966)/, which appeared to fit their curve indicative of the human responses to respiratory exposure to lead, drawn to represent the calculated regression "based on epidemiological data alone." The reference curve, in itself, is a product of essentially speculative numbers, insofar as the latter represent the intensity of the exposure to lead which was attributed to certain groups of persons that have yielded points on the curve. Of greater importance, however, is the fact that data were lifted from a controlled experiment which demonstrated that the slight (and perhaps insignificant) progressive increase in the concentration of lead in the blood of our subjects coincided with an irregular but progressive increase in the alimentary intake of lead on the part of the Subjects. As an investigator, I would not dare to interpret these slight increases as expressions of an excretory response to the absorption of lead in the respiratory tract, especially since a further experiment (under way) can be expected to resolve the issue.

The question involved here, is the extent of the absorption of lead within the respiratory system as a whole, following the inhalation of air containing a particulate compound of lead in a specific state of subdivision. There is no "dispute" here, since the facts are yet to be established. Our experiments with lead sesquioxide in a dispersion of particles having the mean diameter of 0.05 micron have indicated that from 35 to 48 percent of such particles were retained within the normal human respiratory apparatus. Respiratory absorption occurred, undoubtedly, but not nearly to the extent predicted by such a degree of retention; the results, together with other considerations, indicate that it may have been as little as 10 percent of that which has been inhaled. The facts here are uncertain and the effort is being made to establish them (in relation to particles of variable size and composition) by direct experimentation. Since this is difficult and time-consuming, even under the controlled conditions of the laboratory, it is hardly to be supposed that the truth can be ascertained by observations in the highly variable environment of groups in the general population. Nor is it possible to extract precise information from relatively crude environmental data by the most refined process of mathematical manipulation.

The authors dismiss our estimate, supported by many years of investigation of experimental subjects and specific groups of persons, that the absorption of lead from the alimentary tract of persons in the general population is considerably greater than that derived from the respiratory tract. They express the wholly unsupported contrary opinion that, under ordinary environmental conditions, "the total quantity of lead absorbed from the respiratory tract is of the same order of magnitude as that absorbed from the gastrointestinal tract - - - - -." Herein lies the crux of the "dispute," which is quite unlikely to be resolved by anything short of physiological elucidation. Investigations to this end are in progress or are being designed.

By way of a partial appraisal of the familiarity of the authors with the metabolism of lead in the animal and human organism, as well as in the interest of the dissemination of information to those who would attempt to weigh certain remote hazards of the absorption of lead, exception should be taken to a statement in the early part of this article. It is said that, "Stored lead is generally regarded as inert, but it may be mobilized during periods of severe body stress." Neither side of this statement is in accord with sound physiological evidence. Absorbed lead is distributed into the tissues of the body according to a characteristic pattern whereby a large proportion enters into the composition of the skeleton; a counterstream of lead flows from skeleton to soft tissues to excreta, and equilibrium between absorption and release is being disturbed and restored constantly, the preponderance as between the entering and departing streams being dependent on the current rate of lead absorption and the magnitude of the lead content of the skeleton. This relationship, so far as is known at present, is altered significantly only by massive disintegration of the skeleton, as in severe osteoporosis, or by the chelation of lead from the soft tissues, thus disturbing the equilibrium in favor of loss of lead from the skeleton to the soft tissues and body fluids. It has been known for at least two decades that the metabolism of lead in the human organism is one of the stablest of physiological phenomena and that certain general metabolic disturbances, which have been credited with the capacity to "mobilize" lead, as intercurrent infections, shifts in the acid base equilibrium, and gross variations in the metabolism of phosphorous and calcium, are without significant effects. It is reasonable that such should be the case, since the mass reaction of milligrams of lead in kilograms of other minerals in the human skeleton can hardly be expected to exert any highly dramatic chemical effect. Meanwhile the concentration of lead in the ambient air is not a matter of hygienic urgency, so that there is time as well as methodology for establishing the limits of safety in advance of the need for their applications.

Sincerely yours,

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Occupational Medicine

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