ETHYL CORPORATION
RESEARCH AND DEVELOPMENT DEPARTMENT
RESEARCH LABORATORIES · 1600 WEST EIGHT MILE ROAD
FERNDALE 20, DETROIT, MICHIGAN

April 11, 1960

Dr. R. A. Kehoe
College of Medicine
University of Cincinnati
Cincinnati 19, Ohio

Dear Dr. Kehoe:

Enclosed is a copiet of Mr. Bowditch's letter to Mr. Costello and also a copy of the attachment to which he refers. I am sorry that the quality of the copy is so poor but being a copy of a copy it was the best our people could do.

I did not receive from New York a copy of the statement from the Director of Haskell Laboratory which is referred to in Mr. Bowditch's last paragraph.

Sincerely yours,

H. E. Hesselberg

HEH:br
Enclosure

Lead Industries Association

60 EAST 42ND STREET

NEW YORK 17, N.Y.

MANFRED BOWDITCH
DIRECTOR OF HEALTH AND SAFETY

March 21, 1960

Mr. J. A. Costello
Vice President
Ethyl Corporation
[illegible] Park Avenue
New York 17, N.Y.

Dear Joe:

With reference to the current apparently all-out effort of the California State Health Department to establish rather drastic state-wide air pollution control regulations, herewith is a copy of a statement relative to lead which has come to my attention.

As received, this was in the form of a typed draft with penciled amendments, stated to represent "the latest thinking of the State on lead." The copy herewith embodies these changes, but as it did not seem wise to attempt to correct the corrections, there are some obvious errors such as that noted on the first page.

The novel concept that lead is second only to carbon monoxide as a hazard to the public in the general atmosphere, seemingly implicit in the brief summary on page 7, is of interest in relation to the statement by the Director of Du Pont's Haskell Laboratory marked in my other enclosure.

Sincerely yours,

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enc.

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may show an increased mechanical fragility but a decreased osmotic f

These changes may be associated with increased red blood cell breakd

Mechanical and osmotic fragility changes may be reproduced by in vit exposures to lead.[2] However, only the mechanical fragility persists when the treated cells are transfused into the donor.

Lead toxicity is related to the amount accumulated in the At the levels that might occur in community air pollution, there are pr effects of long-term exposure are of primary concern. It seems reas to establish standards upon the basis of levels which would not lead accumulation of lead in the body.

Routes of Exposure

Some ingestion of lead occurs in eating food and drinking water. This dose amounts to an estimated average in North America of about 320 micrograms per day.[3] About 90 percent of orally ingested lead is excreted by the fecal route. Thus, somewhat less than 10 percent is absorbed. The output of lead in the urine of the average North American adult is about 30 micrograms per day when the urine volume is about 1 liter. In balance studies where all lead in food, water, urine and feces was measured over long per

at times, the excretion of lead exceeded the intake by about 20 micrograms per day. Presumably this represents the excretion of lead absorbed from the inspired air.

During periods of prolonged experimental respiratory exposure to lead sesquioxide, (a soluble form of lead) for eight hours a day, five days a week, lead absorption was of the order of 35 to 50 percent.[4] About 35 percent absorption occurs with exposure to particulates having a mean diameter of 0.05 microns, and about 50 percent absorption occurs when the mean diameter is 0.75 microns. It is clear that the proportion of lead absorbed is in the neighborhood of five times greater for exposures by respiratory inhalation than by oral ingestion.

Amount of Safe Lead Absorption

On the basis of Kehoe's work, "....it would appear that the absorption of lead from the alimentary tract is within the limits of safety when the average amount available for absorption is on the order of 0.6 milligrams per day. It seems likely that an alimentary intake of about twice this amount, while devoid of danger over a period of 4 or 5 years, would not be tolerated without significant probability of an injurious effect over a period of 10 or more years.

It appears that about 60 micrograms of lead can be absorbed daily from the alimentary tract with safety while the absorption of 120 micrograms per day is potentially dangerous.[4] If this be a reasonably valid conclusion, it follows that an incremental increase in any type of human exposure to lead that would result in the additional absorption of about 30 micrograms of lead per day would be within the limits of safety while an increase in absorption on the order of 90 or more micrograms per day may be harmful.[4]

It follows that absorption from all routes of a total of 120 micrograms a day might be harmful, while a total of 60 micrograms is presumably safe.

Indices of Exposure

Blood levels for lead appear to give a sensitive indication of the potential toxicity. Values below 75 micrograms per 100 grams of blood indicate a person is not in danger of developing lead intoxication; about 80 micrograms, he is in danger of developing symptoms at any time.[5] Likewise, urinary lead levels below 100 micrograms per liter (in the absence of kidney [illegible] micrograms per liter of urine, some incidence of lead poisoning may be seen.[5]

Criteria for the Most Sensitive Group

Though there are no exact data, it is thought that persons with

A number of persons may have significant occupational exposure. The present industrial threshold is 200 micrograms per cubic meter of air. This assumes an exposure during about 40 out of 168 hours in the week.

Table I shows the range of mean urinary lead excretion from groups of persons with various occupations.

TABLE I

URINARY LEAD EXCRETION IN MICROGRAMS PER LITER OF MEN IN VARIOUS OCCUPATIONS

Subjects	No. of Samples	Mean Lead in Urine in Micrograms per Liter
Garage Mechanics[6]	26	77
Garage Mechanics[6]	201	86
Storage Battery Workers[6]		
Slight Exposure	22	124
Moderate Exposure	40	176
Severe Exposure	9	330
White Lead Workers[6]	86	241

Subjects	No. of Samples	Mean Lead in Urine in Micrograms per Liter
Traffic Officers, at the Holland Tunnel		
Assigned to tunnel duty	43	80
Assigned to outside duty	20	105
Assigned to desk or garage duty	16	71

Another rather poorly evaluated source of lead exposure occurs from cigarette smoking. Smoke was collected from an automatic smoking apparatus and showed 0.1, 0.33, and 0.19 micrograms of lead per puff. 780 cigarettes from five different brands were used in the determination of the value of 0.19 micrograms.[8] In another laboratory, 0.2 to 0.6 micrograms of lead was found in the smoke of two types of cigarettes.[9]

Calculations based on these estimates indicate that a heavy smoker may absorb a significant amount of lead.

Basis for Standards

Because of the frequency of other exposures to lead it seems reasonable to allot to community air pollution exposure only a portion of the allowable body burden as estimated by absorption or excretion. Based on the above data these allowable values would be:

a) an increase from 30 micrograms per day to 120 micrograms per day in absorption, or,

b) an increase in daily excretion of from 30 micrograms to 100 micrograms per liter of urine. (Assuming a urinary excretion average of about one liter per day.)

Common occupational exposures are associated with additional urinary excretion of 20 to 50 micrograms. Less common occupations have even higher levels

It therefore seems reasonable to allocate to community air pollution exposure about half of the allowable body burden or say 45 micrograms per day of additional lead absorption.

If one assumes that the lead in air pollution is in the most soluble form, and that 50 percent of inhaled lead in air is absorbed, these assumptions represent the maximum conditions which existing data would support.

Assuming 15 cubic meters of respired air per day, one then might calculate the air pollution standard as:

$$\frac{45 \times 2}{15} = 6 \text{ micrograms per cubic meter.}$$

Since the estimates of lead absorption for the average person included a certain amount of lead from air pollution, it is possible that the above figure should be considered as additive to that to which the "normal" subjects in Cincinnati had been exposed, namely, 1.0 to 1.2 micrograms per cubic meter.

There is however a great deal of uncertainty concerning the proportion of the inhaled lead which is absorbed. Until there is some additional data on this, or on the average blood or urine excretion levels for groups of persons with various air pollution exposures, no reliable standard can be set.

Present Values of Atmospheric Lead

The National Air Sampling Network[10] reports that the nationwide average value of lead in air was 1.4 micrograms per cubic meter. Pasadena, California had an average value of 3.2; Berkeley 3.0; San Jose 0.9; San Leandro, 1.3; and Los Angeles, 3.5 micrograms per cubic meter. Most of these values were averages of several years' data. In 1954, the average of 23 determinations in Pasadena showed a value of 5.7 micrograms per cubic meter. Examination of the data by month showed a decided tendency for high values to occur in the months of September through December. This is shown in Table IV.

Tetraethyl Lead. 1959. pp.56-57.

5. Kehoe, R.A. The Behavior of Lead in the Human Organism in Relation to

Los Angeles.

Hyg. & Toxicol. 15, 306, 1933.

7. Public Health Bulletin No. 278. A Medical Study of Men Exposed to Measured Amounts of Carbon Monoxide in the Holland Tunnel for 13 Years. U.S. Public Health Service, 1942.

8. Cogbill, E.C., and Hobbs, M.E. Tobacco Science. May 10, 1957, p. 24.

9. Kehoe, R.A., and Cholak, J. (Personal Communication.)

10. Air Pollution Measurements of the National Air Sampling Network. Public Health Service Publication No. 637, 1958.