

LEAD IN THE ENVIRONMENT OF MAN

I. Distribution of Lead in Nature

1. In crust of earth (land and water)

(a) Land

Ubiquitous mineral in variable quantities in various areas

In all stones, which disintegrate to form soils

Concentrated in certain deposits with other metallic elements

In certain areas a concentrated ore comes to or near the surface

Certain surface deposits are relatively soluble, as for example
the carbonate

(b) Water

Rainfall ^{and into} percolates through upper layers of earth, runs off into rivulets,
larger streams, rivers and eventually into sea. Accumulates in ponds,
lakes, sub-soil ^{and} channels

Water at deep levels [>] including hot springs, is likely to be high in
mineral content, including lead

2. In Atmosphere

Picked up by currents of air from soil

Contaminated by volcanic effluvia

Contaminated by combustion (forest and grass fires)

Involved in interplanetary debris, meteoritic disintegration

3. In Vegetation

Growing out of soil and watered naturally (absorption through roots)

Contamination by lead-containing soil on surface

(Absorption through leaves?)

from air-borne lead?

from surface contact?

Uneven distribution within plant (stalk and foliage, fruit and seeds)

(Variable with variations in lead content of soil)

(Variable from plant to plant)

(Selective absorption)

4. In Animal Life Using Vegetation and Other Animal Forms for Food

In sea - salt water

In Streams - unsalted water

On land

Pattern of distribution - lead in skeleton is something of a ^{so far} sparing factor, in that it ^{animals is} may not certainly will not quantitatively be taken into as absorbed in the body of man

5. In all natural liquids and beverages

i.e., water, fruit juices, succulent herbage used to quench thirst, ^{so far} oils ^{and} ^{50 ps.} latexes

6. In all Men in all Societies ^{so far} subjected to investigation

Order of magnitude of natural body burden of persons thus far examined appears to be lower than that of modern man - arrived at by indirection, however, from estimates of intake and output and lead content of blood, and, therefore, not strictly quantitative. Best values inferred from data indicating that intake of a primitive people amounted to 1/3 to 1/2 of that of U.S. citizens.

II. Distribution of Lead in Modern Environments

Must vary quantitatively with numerous factors, under influence of

1. State of Society with reference to technological developments.

Mining, smelting, refining, alloying, and utilization of lead, its alloys and its many chemical compounds have progressed through the centuries. During this long period, lead has displaced other materials in many uses, and has been displaced in whole or part from many others. It is still one of the most useful of the minerals and metals.

2. General and Specific Factors in Artificial Distribution of Lead in the Human Environment

- (a) Lead from the mineral deposits in the depths of the earth has been mined in great quantities and distributed over the surface of the earth in many forms, some of which gain access to vegetation and animal life (including man)
- (b) Contribution to air-borne lead
 - (1) Combustion or volatilization of contaminated materials painted, coated, sprayed material or surface (painted wood, sprayed vegetation, battery boxes, etc.)
 - (2) Manufacturing activities that contaminate neighboring atmosphere including operations and industrial burning grounds
 - (3) Combustion of fuels for heating homes, public and private buildings and industrial establishments, and for driving the wheels of industry - wood, peat, coal, petroleum
 - (4) Combustion of fuels in motor equipment, cars aeroplanes, etc. especially leaded gasoline
Wide areas that are involved in fall out from aeroplane traffic
 - (5) Air borne dust of streets, highways and contaminated land
- (c) Contribution to Food and Beverages
 - (1) Deposition of lead on soil contributing to absorption into plants used for food (forage crops, etc.) for animals and man
 - (2) Deposition of lead on vegetation used for food for animals or man. From near by industrial sources, or from sprays or from highways.
 - (3) Application of lead in paint, on surfaces of and within buildings and enclosures accessible to animals, especially cattle to be used as human food - (little transmission in milk, some in eggs)
 - (4) Contamination through storage, transportation, packaging, processing (grinding, cutting, pulverization, homogenizing) in lead-containing vessels and containers
 - (5) Contamination in household, through equipment for cooking and mixing, and through use of containers and tableware (pewter and ceramic ware and repaired (soldered) cutlery.
 - (6) Certain beverages as alcoholic drinks (illicit whiskey and wines especially) may be contaminated to an highly significant degree

III. The Metabolism of Lead in Man

1. In primitive man

Intake and output (both estimated)

2. In healthy men in the U.S.A.

(a) Intake

(1) By ingestion of food and beverages, and (under appropriate conditions) from air.

Rejection in alimentary tract (80 to 95 percent)

Absorption in alimentary tract dependent upon physical state
bullets vs. dust

Dependent upon solubility in intestinal contents

Dependent upon concentration

5% or less up to 20% or more

(2) By inhalation

Large particles filtered out in upper respiratory tract and
swallowed

Some proportion of all particles but especially the smaller ones,
exhaled with expired air (25 to 75 percent exhaled under
appropriate conditions)

Some additional proportion of particles not rejected at once by
being exhaled in expired air, are cleared from the lung by
other mechanisms, within short or longer periods.

It is impossible, at present, to determine the precise amount
of the air-borne lead in particulate form, which is absorbed
into the body during intermittent or continuous inhalation.
It is, obviously, considerably less than that which is retained
within the respiratory tree after inhalation. Evidently, some
means of further clearance from the respiratory tract and from
the body is operative.

(b) Output

(c) Body burden

IV. Tolerable Levels of Intake

1. By Ingestion

2. By Inhalation