GUIDANCE TO DEAL WIT H THE LEAD POISONING PROBLEM IN THE AFTERTIME

Table of contents

1. SUMMARY

In order to deal with the health hazard that lead will present after the pole shift and associated cataclysms, a review of the actual knowledge on lead and lead poisoning is offered in this article. Only the topics, which appear relevant to the pole shift and the Aftertime, have been developed.

ZetaTalk® indicates that lead poisoning will be a problem after the pole shift. This has triggered a search for solutions and some of them like water distillation and chelation therapy are presented in Troubled Times.

At the present time, the lead poisoning problem is clearly associated with industrialization and many characteristics typical of a third density culture are related to this problem. In accordance to what is reported in ZetaTalk®, it is striking to learn that atmospheric lead is clearly associated with volcanic activity and that a cycle resulting, with time, in lead disappearance from the biosphere, can be deduced from the scientific literature.

In the Aftertime, the lead burden coming from bone demineralization of undernourished survivors will add to the volcanic lead intake. The lead blood level of the population is already so close to the toxic threshold that even well prepared communities could be affected.

To avoid poisoning, lead should be prevented from entering the body. Dust mask can be used to reduce inhalation of lead containing volcanic dust particles. Drinking water will certainly be a major source of lead poisoning and will require to be depleted of lead. Although there are several ways to achieve this, distillation is probably the easiest method. When it is not possible to treat water to remove lead, filtered mineral rich water, containing calcium, magnesium and not acidic is preferable. There are many ways to reduce ingestion of lead from food. Gardening practices and plant selection in outdoors lead contaminated environment can minimize lead incorporation in crops. The addition of organic matter to the soil as well as a pH higher than 6.5, decreases lead incorporation by vegetables. Fruiting crops should be preferred to root crops and leafy vegetables should only be grown inside. Lead concentration in soil will be higher than in plants, therefore, vegetables should be carefully washed before consumption. Animal food tends to have lower lead levels than plants. Lead is more or less incorporated depending on animal species. When eating animals, poultry should be preferred; pigs, goats and rabbits come next, and finally cattle and sheep. Adult animals are also safer, since young animals concentrate more lead than adults. Lead concentrating organs such as bones, liver, kidney, bone marrow, brain and testes should be avoided. Lead in seawater is very dilute and the concentration of lead in seafood should remain low.

An appropriate diet can minimize lead bio-availability. Food rich in vitamin C, iron, calcium, and magnesium reduce lead assimilation. Weeds or plants containing these chemicals can be identified and selected from existing databases. Dietary supplements of these components are a good way to reduce assimilation and to help the body to get rid of absorbed lead. If the first measure to prevent contamination is avoidance of exposure to lead, the second one is to use mineral supplementation. Mineral supplements and vitamins should be stocked and more importantly, natural sources should be identified. Alimentary chelator, either synthetic (EDTA, Succimer) or found in plants (citric acid, oxalic acid) could be used as oral additives to prevent lead poisoning.

Lead blood tests will not be available after the pole shift. Recognition of lead poisoning will essentially be based on the observation of the symptoms. Several forms of treatments will be possible. Provided that the appropriate compounds (such as DMPS and DMSA which are administered orally) have been stocked, chelation therapy will be possible. There are also alternative treatments such as essential metal ions supplementation, heat depuration and homeopathy. Medicinal plants (rich in essential metal ions or natural chelators) might also be effective. Since the body has, to some extent, the ability to get rid of the lead it has assimilated, avoidance of any additional incorporation is the first treatment that should be applied. Ideally,

every individual presenting symptoms of lead poisoning should be treated, especially when life is threatened but to avoid permanent neurological damages, children should be the treated in priority. Some lead poisoning genetically susceptible individuals will also require special attention.

Additional steps to prevent lead contamination, which is always possible in high tech, hydroponics type, food production systems, can be implemented without too much difficulty. In indoor recycling food production systems, lead biosorption using plants or microorganisms can be used to keep the system safe. A plant or microorganism biosensor, also compatible with this kind of food production system is useful to monitor the lead level of the system.

2. INTRODUCTION

Lead (Pb) is rather stable; it hardly dissolves in water unless the water is acidic and/or "soft" (low mineral content). On the contrary to magnesium (Mg), calcium (Ca), zinc (Zn), lead is not an essential metal. Lead does not have any physiological role in the body. Lead poisoning, which has been known since the Antiquity is clearly correlated to industrialization. To various extents, every individual is affected by elevated blood lead level, which is a direct consequence of human activities. When lead is incorporated in the body, it is mainly distributed in the skeleton (94%) where it has a half-life of more than 10 years[i]. Lead can cause long-term damage to the brain, nerves and kidney. Due to the large quantities handled since the industrial era and its extreme toxicity, lead has been recognized as a major hazard. With a brain under development, children are more susceptible than adults to lead poisoning.

According to ZetaTalk®[ii], lead coming from volcanoes emissions will be a serious problem after the pending pole shift. The awareness of the potential danger of volcanic lead for human health brought up in ZetaTalk® has triggered, in Troubled Times[iii], a search for solutions. Some of them such as water distillation and recycling have been proposed in ZetaTalk®.

The purpose of this guide is to provide information on the way to deal with the lead hazard in the context of the Aftertime. It is intended to the survivors of the pole shift, to help them with the lead poisoning problem. Lead is insidious and is a cumulative poison. A better understanding of lead (chemistry, toxicity) and lead poisoning (symptoms, treatment) gained from the actual knowledge can certainly help.

This guide is organized as follow: First, the information provided in Zetatalk® on the lead poisoning problem is recapitulated in the 'Introduction' section. Next, a review of the current knowledge on lead poisoning, which appears relevant to the Aftertime context, is presented in the 'What is known about lead and lead poisoning' section. Finally, solutions are proposed in the 'Lead poisoning & Aftertime' section.

2. 1. Opening remarks

In scientific literature, a common view on a particular subject in not reached easily. This is true for several issues concerning lead and lead poisoning where opposing currents of opinion are present. For instance, some of the mechanisms of lead toxicity, particularly the free radical theory, are still matter of discussion. Other examples of controversy are the beneficial aspect of essential metal ions supplements to reduce lead assimilation and of chelation therapy to prevent cardiovascular diseases[iv]. There are also conflicting reports on whether or not, oral chelators might increase the bio-availability of lead.

In this study of the vast amount of information on lead and lead poisoning available on the Internet and on scientific literature, it was necessary to take position on several of these controversies. In this guide, as often as possible, the references and sources are mentioned. Most of the time, these publications are available on the Internet. So the reader has the possibility to eventually develop different opinions and alternative solutions. These references can also be used as a starting point to get additional information for a better or more specific preparation.

Even with the large amount of information provided in ZetaTalk®, it is still very difficult to get a clear picture of life in the Aftertime. Moreover, the conditions of live will vary greatly from places to places and will also depend on the level of preparation of communities. Since the actual knowledge of lead is discussed in the context of the Aftertime, the choices that are made and the solutions that are proposed in this paper, reflect this fuzziness.

Finally, the amount of information on lead poisoning is so vast that it can only be covered partially. Other readings or a different understanding of the literature on these topics can also lead to different choices.

2. 2. Lead and pole shift cataclysms. What do the Zetas say

Lead poisoning is mentioned several times in ZetaTalk®:

?? **Safe Water**[v]

"During the pole shift volcanoes, old and new, will violently explode. The resulting ash will sift down from the upper atmosphere for decades, poisoning ground water. Humans driven to drink this gritty water will find more than grit between their teeth, they will find their nervous system beginning to fail them, their eye sight fading, and their digestive system intolerant of any food they may find. We are speaking here primarily of lead poisoning, which is not a problem man expects from the water nature provides. Lead settles and over eons settles down out of the way, but after a cataclysm the lead heavy mantle has been spewed out over the landscape, most of this vomit in the form of fine billowing dust.

Will the ground water not be safe? Depends. During the cataclysms the ground is heaved and jerked, and any wells or piping will be shattered. In that the ground water is as likely to carry poisons as the surface, having filtered down from the surface, what looks like pure water from underground may be, again, a slow death. Ground water also is subject to contact with the lead heavy mantle, which most often does not make it all the way to the surface during eruptions. If one cannot trust the usual water supply, what to do? Distillation processes or recycling water known to be pure are two approaches likely to provide a steady supply of water. This may seem tedious to those so used to taking fresh, pure water for granted, but those who prepare for the times ahead will not find themselves suddenly without one of life's necessities.

Man dies without air in minutes, without water in days, and without food over weeks. Bread may be the staff of life, but water is life itself!"

?? **Polluants**[vi]

"Mankind lives in an uneasy peace with the poisons he has developed. Some of them, such as lead spewed into the air by cars burning leaded fuels or the chloride compounds eating into the ozone layer, seem innocuous until a buildup occurs."

?? **Atmosphere Building**[vii]

"Metals washed constantly with a liquid are found in that liquid, thus the concern for lead poisoning when drinking water stands in lead pipes."

?? **How to Prepare** [viii]

"Rivers and seas may be poisoned, what with the volcanic dust falling everywhere, so fish tanks fed from algae grown in human sewage will likewise be most abundant."

?? **Terror Tactics**[ix]

"Poisoned water has long been a means of wiping out a village, or protecting turf, over the ages. Unsafe water is a factor mankind has had to deal with in any case, as water found standing in ponds or even flowing in streams can carry organisms causing disease or heavy metals such as lead, so most cases of poisoning by water occur naturally, not by the hand of man. Man has poisoned himself, in fact, by using utensils that leach lead, or allowing sewage water to leach into his drinking water, or allowing corporate interests to prevail so that PCBs or other chemical poisons degrade the quality of life of millions to allow the wealthy few to step higher on their perch."

?? **Inland Lakes**[x]

"The oceans have resources not available to inland lands, in that the oceans flow around the world. This not only shares nutrients, but dilutes pollution. The oceans are thus able to gain from being positioned under the equator, where kelp can gain maximum sunlight. To the degree that an inland lake is free from volcanic ash, is not dumped excessively so that the water becomes poisoned, and to the degree that the land is under intense sunlight, equatorial preferably, it will flourish. Water has advantages that land does not, after a pole shift. Ash

settles to the bottom, where on land remains on the surface. Water also traps heat, creating a middle ground where temperatures rise and fall slowly. Thus, life in the water can survive a winter, where on land would freeze and starve. Water pools often have nutrients that have drained from the land, during runoff. Where sewage is considered a nuisance by man, it is the basis for much future growth. From death comes life, in nature. Thus, water pools flourish and is only considered a foreign environment by man because he is a land animal.

Water based farming should be considered by survival groups at least to the extent that land based gardening is. Fish often cast off heavy metal pollutants such as lead, and can live without light. Thus, this is a fruitful avenue for survival groups to consider. Inland lakes should be examined based on the following:

1. *Are they downwind from volcanoes, and if so, can they drain or have enough flow such that the pollutants likely to accumulate can dilute and flush out.*
2. *Do they have positive run-off, rich in humus or animal droppings, so that plant life in the lake has something as a nutrient.*
3. *Are they deep enough to encourage circulation necessary for complex life forms, not just slime algae in shallow pools, but crustaceans, etc.*

What flows in, and through, these lakes, such that the lake can be trusted to remain fertile, and will not be poisoned by those upstream."

?? **Death Wish**[xi]

"There are children who will be left orphaned, without protection, vulnerable to the worst nightmares. There are those who will wish to stay alive for the safe of their dependents, children or others in poor health or needing them, who will need advice. *What to eat? Where to go? How to distill the water to avoid lead poisoning? Where to get Vitamin C? And what to expect over the next few months? Should they move to the hills or remain along the rivers where fish abound? Should they rebuild a shelter or plan a houseboat to accommodate the rising water? Should they join this group or that, or take to the road? What country or direction is the best direction, if moving is the obvious choice? How long will this last? Will help arrive to rescue them? All these questions are those you can* help *them with."*

?? **Nuclear Winter**[xii]

"Depending upon where one is, downwind from volcanoes, the ash will poison the water and soil. This tends to be the immediate effect after a violent *burping, not a lingering effect. However, since violent burping will occur big time during the shift,* all *ash afterwards will carry poisons. Thus, until the rains wash this away, some months at best, drinking water should be distilled. Ground water may carry these poisons for a longer time, depending upon how close to the surface this is, the flow patters, etc. Water in lakes and oceans dilutes, where ground water stagnates. Fish likewise have an ability to* exclude *lead, though do absorb other heavy metals such as Mercury. Likewise, water retains warmth, and algae grows in abundance in places land based plants cannot tolerate. Thus, this resource should be explored, and explored* thoroughly, *prior to the shift, as a real survival technique."*

?? **What will Survive**[xiii]

"One should not assume a grim picture of life after the cataclysms. No more birds singing, no more pizza. This is not a true picture. Birds survive, and sing by nature, and we suspect that as cookbooks and ingredients will also survive, there will be pizza. Where there will be a chronic dusk, due to volcanic dust, for at least two decades, life will go on. Not all streams and lakes will be poisonous, but the cautious should plan ahead, and anticipate these occurrences. Safe food and shelter can be arranged, and this does not require great wealth or strength. This requires common sense."

2. 3. Lead poisoning in Troubled Times

Solutions to lead poisoning have been described in Troubles Times[xiv]. These solutions deal with the 'lead testing', the 'chelation therapy' and also with the 'lead free water' problems. In addition, the water distillation process[xv] is presented and a prototype drinking water distillation system is described[xvi].

3. WHAT IS KNOWN ABOUT LEAD AND LEAD POISONING

Much information on lead and lead poisoning can be found in the scientific literature. Below, a short and incomplete review is presented, mainly focusing on the aspects, which appear the most relevant to lead poisoning in the post pole shift era.

3. 1. Historical aspects of lead poisoning

Lead poisoning (also called saturnism or plumbism) has already been observed in Antiquity (lead was used in some cooking utensils, in contact with food). Lead poisoning has been linked to the fall of the Roman Empire. It was sporadically mentioned until the 19th century where it reached epidemic dimensions. Lead poisoning is clearly correlated to industrialization[xvii]. As stated in ZetaTalk®, saturnism has been observed in some regions where lead pipes where used for drinkable water, especially when the water is acidic, which favors the dissolution of lead. With the introduction of tetraethyl lead in gasoline, lead poisoning became a serious environmental pollution problem. Since lead has been restricted from use in gasoline (started in 1972 and completed in 1995), blood lead level in the population has been decreasing (almost fourfold reduction in US children[xviii]). Although lead poisoning has been known from the time of Hippocrates, a specific treatment (chelation therapy) became available only few decades ago. Chelation therapy dates back to 1941, when citric acid was used to treat lead poisoned patients. Ethylenediaminetetraacetic acid (EDTA), a more efficient lead chelator was introduced in the 50's[xix].

3. 2. Lead poisoning and our 3rd density culture

A clear responsibility of industry in lead pollution and consequently in lead poisoning has long been established: *'Lead is perhaps the longest used and best recognized toxic environmental chemical, yet it continued to be used recklessly until only very recently. Lead is thus a lesson in the limitations and strengths of science, human conscience and common sense'*[xx]. In addition, industrial lobbying to maintain the use of lead and to prevent biomedical research in this field is notorious: *'Despite over 100 years' knowledge of the special hazards of lead exposure for young children, it has taken over a century fo r effective primary prevention to be adopted. Obstacles to primary prevention have included deliberate campaigns by industry to prevent restrictions upon such uses on lead as plumbing, paints, and gasoline additives; influence of industrial support of biomedical research at major US medical schools; lack of appropriate policy mechanisms to identify and control lead exposures; and opposition to investing resources in lead poisoning prevention'*[xviii]. A simplistic view of toxicology where an effect is solely analyzed in term of life or death has also been preventing progress in the lead poisoning field: *'New research on lead toxicity has been stimulated by advances in toxicology and epidemiology as well as by a shift of emphasis in toxicology away from binary outcomes (life/death; 50 percent lethal dose) to grades of function, such as neuropsychological performance, indices of behavior, blood pressure, and kidney function'*[xxi].

Lead exposure, when assessed in bone or teeth has been correlated to high school drop out and also appears as the most reliable predictor of delinquent behavior. Criminality and leaded gasoline consumption peaks coincides. Countries spewing out the highest amount of tetraethyl lead also have the highest crime rate[xxii].

3. 3. Lead and volcanoes

Atmospheric lead coming from volcanoes has indeed been reported by scientists[xxiii,xxiv]. The ratio of lead coming from volcanoes over lead coming from human activities (anthropogenic) is still matter of discussion[xxv,xxvi,xxvii]. Greatly increased concentrations of lead were observed at all altitudes (up to 15 km) for several years after the Fuego and Nevado del Ruiz volcanic eruptions in 1974 and 1985 respectively[xxvi]. The lead fallout measured in a 77 m ice core in Greenland is not constant. The higher lead fallout coincides with high volcanic activity[xxiv].

3. 4. 'Lead cycle'

The lead cycle where lead released during volcanic eruption tends, with time to *"settles down out of the way"* which is mentioned in ZetaTalk®[v] is quite in agreement with the fate of atmospheric lead as it is presently understood. When compared to surface water (3.9 µg/L), lead in seawater is much diluted (0.005 µg/L). Lead tends to concentrate in sediments (20,000 µg/g in river sediments and about 100,000 µg/g in coastal sediments) whereas the average concentration of naturally occurring lead in soil is only 10-30 µg/g.

Water-soluble lead (as lead chloride) has been observed in volcanoes ashes[xxviii,xxix]. Such ashes will leach lead under the effect of rain. Other water-soluble lead compounds such as lead sulfide, oxide or sulfate have been reported in volcanic fumaroles[xxx]. In addition, lead is also carried by running water in an undissolved form (as colloidal particles or larger solid particles of lead carbonate, lead oxide, lead hydroxide, or other lead compounds incorporated in other components of the surface particulate matter from runoff). Atmospheric lead appears to enter the soil as lead sulfate. Since lead sulfate is relatively soluble, it can leach through the soil. Lead may mobilize from soil when lead-bearing soil particles run off to surface waters during heavy rains. Lead may also mobilize from soil to atmosphere by downwind transport of smaller lead-containing soil particles entrained in the prevailing wind[xxxi]. *'When discharged of lead atmosphere declines, lead is slowly removed from the biosphere. An increasing proportion of the circulated lead becomes trapped in compounds that are poorly absorbed by living organisms. While the lead remains at the surface of the earth and in seawater, the amount entering in animals and plants declines rapidly'*[xxxvi]. This 'lead cycle' is summarized in figure 1.

3. 5. Lead and lead salts chemistry

Lead can be found as elemental (metallic) lead (Pb), or as different salts which might be more or less soluble in water, depending on their chemical properties (lead sulfide, phosphate, carbonate, and oxides are insoluble or hardly soluble in water; lead chloride is slightly soluble; lead acetate and nitrate are soluble in water). Another chemical form of lead is organic lead where lead is part of an organic molecule. Lead dissolves reasonably quickly in acid solution. Lead is attacked by water containing air, nitrates, ammonium salts or carbon dioxide[xxxii]. According to ZetaTalk® ('Ocean Life')[xxxiii], after the pole shift, the atmosphere and water will be rich in carbon dioxide, … which might in turn increase the mobilization of lead. In addition, the almost constant rain that the earth will experience after the pole shift ('Rebirth')[xxxiv] will carry atmospheric volcanic particles and wash volcanic ashes also increasing the mobilization of lead (figure 1).

3. 6. Lead toxicity

Several million tons of lead are produced every year. A toxic threshold for children has been established at a blood level around 0.5 µM[xxxv] (~10 µg/dl or 0.1 part per million or 0.1 ppm; 10 µg would be the equivalent of the amount of matter in a pencil point and a dl is 100 ml or approximately the equivalent of ¼ of an Imperial unit measuring cup). In view of the amount

of lead generated every year and its high toxicity, lead has long been recognized as a major hazard. As mentioned in ZetaTalk®[vi], lead is a cumulative poison[1] to which we are all exposed, to some degree. In the mid-1990 the average lead blood level in the U.S. population was in the 2-4 µg/dl range. The blood lead levels in pre-Columbian American, has been estimated, based on bone studies, at less than one tenth of the current levels[xxxvi].

Lead is not natural within the body and is not required in the diet. *'The disturbing fact is that the natural levels in human in blood are already very close to that which is considered to be a reasonable toxicological limit, not leaving us with any margin for exposure to lead'*[xxxvii].

?? **Why is lead toxic**

To some extend, the biochemical basis of lead poisoning is known[xxxviii]. Any ligand with sulfhydryl groups (-SH, cystein residues in proteins) is vulnerable. Lead is an enzymatic poison; it replaces zinc on heme enzymes and induces a decrease of production of heme. Lead interacts with calcium in the nervous system to impair cognitive development[xxxix]. The mechanism for the central nervous system effects of lead is unclear but involves lead interactions within calcium-mediated intracellular messenger systems and neurotransmission[xl]. Ionic lead (Pb^{2+}) enters the cells via plasma membrane Ca^{2+} channels[xli,xlii].

Another hypothesis on the mechanisms of inorganic lead toxicity is correlated to the generation of free radicals[xliii,xliv,xlv,xlvi,xlvii], very deleterious to the cells and to the body. To counter this toxic effect, antioxidant enzymes are induced in lead exposed individuals, but once the antioxidant capacities of the body are overcome, the harmful effect of lead takes place. This can occur for low concentrations of lead.

?? **What chemical form of lead is toxic**

The toxicity of the different chemical salts of lead depends on their solubility and how they are incorporated within the body[xlviii]. Whatever the chemical form in which lead enters the body, it is the dissolved form of lead (ionic form, Pb^{2+}), which competes with essential metal ions (such as Zn^{2+}, Ca^{2+} and Mg^{2+}) for binding to metallo-enzymes (enzymes which require metal ions for activity). In interfering with the activity of these enzymes, it is the ionic form of lead, which is toxic.

One of the worse form of lead, as far as toxicity is concerned, is organic lead (when lead is included in an organic molecule), probably because it is more easily absorbed in the body[xxxviii]. This form of lead should not be a problem in the post pole shift era unless lead is incorporated in organic molecules which are formed above volcanoes and in lighting flashes, as described in ('Manna from Heaven')[xlix].

3. 7. How does lead enter the body

Lead can enter the body mainly through inhalation and through the gastro-intestinal track. Through either route, lead enters the bloodstream and therefore can be distributed to various organs and body tissues (figure 1).

?? **Inhalation (vapors and dusts)**

Inhalation of vapors and dusts containing lead is the most dangerous route of entry; lead rapidly reaches the blood stream and is practically completely absorbed. Poisoning occurs upon breathing contaminated soil, dust air or water. Lead dust, fumes or vapors are more easily absorbed from the respiratory tract.

?? **Ingestion**

Lead also enters the body through the gastro-intestinal tract. Eating food grown on contaminated soil or food covered with lead-containing dust, eating lead-based paint chips,

drinking water that comes from lead pipes or lead soldered fittings are typical routes of lead poisoning.

?? **Through the skin**

Inorganic lead is not significantly absorbed though the skin, but organic lead can enter the body though the skin.

?? **Through the blood (mother-fetus)**

Lead can cross the placenta barrier; this is a source of lead poisoning for unborn children when their mothers are contaminated. Since lead accumulated in the bones is mobilized during pregnancy, lead poisoning is passed from generation to generation. Women exposed to high level of lead during childhood are therefore more likely to bear children with significant learning disabilities. Lead can also be passed to children from breast milk[1].

3. 8. Bio-availability of lead

'The bio-availability is the extent to which the metal concerned is transferred from the gastro-intestinal tract to the blood and this depends on the chemical behavior of the element in the gastro-intestinal tract, where the pH may vary from ~2 in the stomach to about pH 8 in the small intestine, where high concentrations of complexing ligands are also present'[li] Between 50 to 80% of ingested lead (metallic form) is not assimilated and is eliminated in feces. However, due to the acidic conditions of the stomach, small amount of lead is metabolized. It is usually believed that metal ions can cross mucosa in non-ionized form. It is the ionic form of lead (Pb^{2+}) which is captured by chelators and which interferes with enzyme activity. Lead contaminated water (when filtrated) only contains ionic lead. This lead form is readily absorbed in the body. For the same reason, soluble lead salts are particularly toxic. Once in the blood stream, lead is excreted in urine, discharged from gall bladder to feces (degradation of hemoglobin that binds lead), it is also excreted in the skin, hair, nails and in the breath. From the blood stream, it also enters the cells where is interferes with enzyme activity, it also distributes in soft tissues and mainly incorporates in bones (figure 1). Lead containing dust particles when inhaled (it seems that particles smaller than 10 µm are not filtrated in the nose) stay in the lungs and depending on their chemical form dissolve more or less rapidly. Inhaled lead is almost completely assimilated. Again when dissolved, lead can enter the blood stream. The distribution of lead in small particles would maximize, upon ingestion intestinal absorption. Fine particles of lead are attacked by weak acids such as fruit juices, fatty acid in alimentary oil and acetic acid of vinegar.

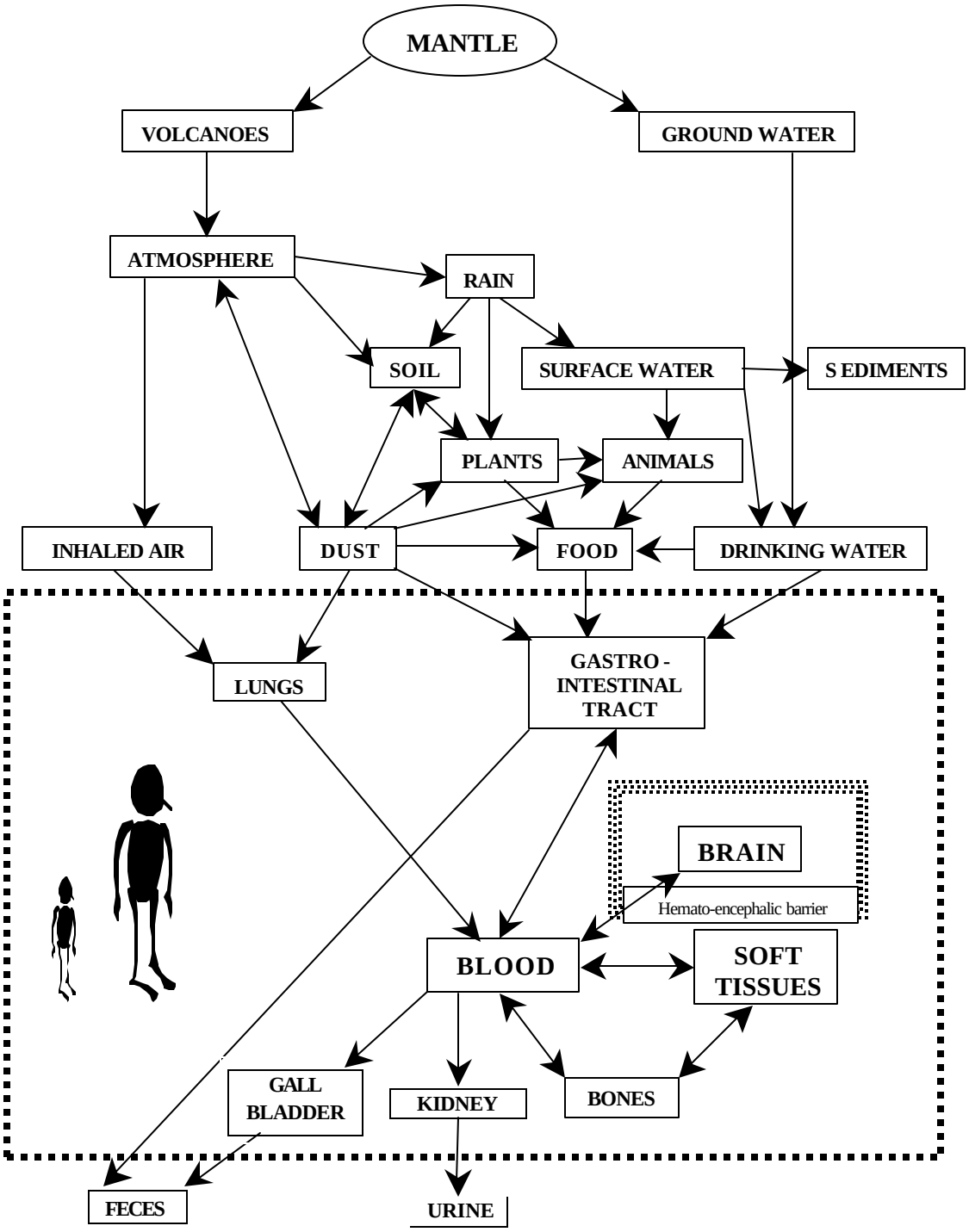

Figure 1: The fate of lead in the Aftertime (adapted from ref. [lii]). This schematic representation describes the pathways of lead in the Aftertime from the heavy mantle to man (dotted rectangle). Lead body distribution and elimination is also shown. The exploding volcanoes will release tremendous amounts of lead containing ashes in the atmosphere. In the addition to the direct lead heavy mantle contamination of ground water, lead containing volcanic ashes will contaminate surface waters. Rain will also carry atmospheric lead and will wash lead from the volcanic ashes on the ground. Plants will be contaminated by lead, upon incorporation from the soil or water and also by atmospheric dusts. Similarly, animals will be contaminated. The sources of potential contaminations of human survivors are water, plant and animal food, soil dusts and 'atmospheric lead'. Once in the blood stream, lead is mainly incorporated in bones. Lead is slowly eliminated in feces and urine.

3. 9. Individual susceptibility to lead

Whereas identical twins seem to have similar response to lead poisoning, some children of the same family (with similar lead exposure) develop more lead poisoning than the others. Since genetic susceptibility differs, some individuals might be significantly more resistant than others[liii,liv]. It seems also that males are more susceptible than females to lead poisoning[Error! Bookmark not defined.].

3. 10. Chelation therapy

As documented in Troubled Times[lv], patients are treated with chelators to remove lead from the body. There are parenteral and oral drugs that may be used. The current understanding of the pharmacokinetics of lead and its alteration by chelating agents is rudimentary[lvi]. Treatment of acute poisoning consists of one or more chelating agents.

?? **Dimercaprol**

Dimercaprol (Dimercaptopropanol, BAL in oil, British antilewisite) binds with lead and is excreted in urine and bile. It was first developed as an antidote for Lewisite (an arsenical chemical weapon). It can only be given intramuscularly. There is a high incidence of side effects: histamine release, fever… Dimercaprol is commonly combined with EDTA to treat lead encephalopathy.

?? **Calcium EDTA**

EDTA binds to lead and is excreted in urine. This agent can be found in a variety of combinations, complexed with calcium, sodium, zinc, … The calcium disodium forms of EDTA which is recommended in the US is $CaNa_2EDTA$ (calcium disodium edetate or calcium disodium versenate). When taken orally (taken by mouth), $CaNa_2EDTA$ has a low availability (less than 5 %). Therefore, for effective treatment, $CaNa_2EDTA$ is administered parenterally and hospitalization is required. Intramuscular injection of $CaNa_2EDTA$ is extremely painful. To avoid severe side effects, $CaNa_2EDTA$ is infused intravenously, slowly during 4 hours in a dilute 0.5 % solution. The usual daily dose is 1,000 mg/m^2 for 5 days. The dose may be repeated every 2 to 5 days as needed. Careful patient monitoring and follow up for kidney and liver function is necessary. The increased excretion of zinc observed upon $CaNa_2EDTA$ injection results in deficiency during prolonged treatment. $CaNa_2EDTA$ is not recommended as the sole chelator to treat patients with the symptoms of encephalopathy.

?? **DMSA and DMPS**

These drugs were introduced in 1975 in Western Europe and in USA. They are effective orally. DMSA appears less toxic than DMPS. Both drugs are found to be as effective as $CaNa_2EDTA$[lvii].

DMSA (2,3-meso-dimercaptosuccimic acid, succimer) is a water-soluble analog of dimercaprol, which has the advantage of oral administration. On the contrary to EDTA, succimer can enter the cells and seems more efficient. It minimally enhances iron, zinc and calcium excretion. Unlike $CaNa_2EDTA$, succimer does not precipitate encephalopathy in human patients. Mild gastro-intestinal symptoms, general malaise, hypersensitivity are adverse reactions to succimer. Give DMSA for 5 days at a dose of 10 mg/kg every 8 hours for 5 consecutive days, followed by 2 weeks more therapy at reduced frequency (10 mg/kg every 12 hrs) for a total of 19 days. Additional courses may be given, if necessary, after 2-week interval[lviii]. The 100 mg capsules can be mixed with food or fruit drinks. Succimer has a "rotten egg" sulfur odor.

DMPS (2,3 dimercato-l-propanesulfonic acid sodium salt, dimerval) has received wide attention worldwide. In Europe and in Asia it has become the treatment of choice for most heavy metal intoxications. Patients are treated orally with 250 mg/day for 20 days.

?? **Penicillamine**

Penicillamine (D-BB-dimethylcystein, cuprimine, depen) may be given for oral treatment of lead poisoning, but patients might develop side effects such as hypersensitivity, nausea, vomiting. The usual dose is 20 to 30 mg/kg per day and the typical duration of the therapy is 4 to 12 weeks. The overall toxicity profile relegates it to a third-line reagent, indicated only when unacceptable reactions have occurred to succimer and $CaNa_2EDTA$.

3. 11. What is a chelator

"The word chelator is derived from the Greek term for claw. Chelators form a chemical claw around the heavy metals and allow them to be excreted"[iii]. The four carboxilate groups of EDTA, with their negative charges at physiological pH can bind tightly the positively charged lead ions. When lead is complexed or sequestered by a chelator of sufficient affinity, it is no longer available for its targeted enzymes and hence is no longer toxic. The complex formed by lead with EDTA is so stable that it virtually stays in that bound state and is excreted in that form in urine. Not only a chelator is characterized by a metal ion affinity, but also by its selectivity for a particular ion in the presence of other metal ions. The binding of metal ions by a chelator can be viewed as an equilibrium:

Chelator + Metal ion ? Chelator bound Metal ion

The amount of bound metal ion (and also the concentration of free metal ion) depends on the affinity constants of the chelator for the metal ion. The higher the affinity, the lower remaining free metal (the toxic form). The affinity of a chelator for different metal ions varies, depending among other things on the size of the metal ion, on the solvatation state of the metal ion and on geometrical aspects of the metal ion coordination. The selectivity of a chelator for a particular metal ion can be defined as the ratio of the affinity of the chelator for the metal ion of interest over the affinity for other metal ions. In the case of lead poisoning, it is interesting to consider the affinity of a chelator in the presence of essential metal ions.

In Table I, the affinity constants of several common chelators for Pb^{2+} are indicated together with the affinity for Mg^{2+} and Ca^{2+}. This table shows that EDTA would bind as much Pb^{2+} as Ca^{2+} or Mg^{2+} even when Pb^{2+} is 10 million fold less concentrated than Ca^{2+} or 1 billion fold less concentrated than Mg^{2+}. The presence of sulfydryl groups such as in cystein in a chelator is probably a factor, which enhances its selectivity for Pb^{2+} versus Ca^{2+} and Mg^{2+}. The affinity constants in Table I come from different kind of experiments performed by different research groups and these values cannot rigorously be compared, they are only indicative. However, they are probably the most reliable values found in the scientific literature for these chelators. Another issue is that they were determined *in vitro* in conditions approaching physiological conditions, however, the real values (in term of affinity and specificity) in the body, in the presence of multiple metal ions might differ substantially.

Table I: Comparison (*in vitro*) of the affinity of different common chelators for Pb^{2+}, Mg^{2+} and Ca^{2+}.

	EDTA	Citric acid	Oxalic acid	Acetic acid	Cystein	Ascorbic acid
Log $K_{(Mg)}$	8.85	3.45	2.76	0.55	NA	0.20
Log $K_{(Ca)}$	10.65	3.45	2.46	0.57	NA	NA
Log $K_{(Pb)}$	18.00	4.44	4.20	2.15	12.300	1.77

These values are taken from Critical stability constants Vol VI (and previous volumes), Martell and Smith[lix]
One unit correspond to one order of difference in affinity for the indicated metal ion

3. 12. Lead Assays

There are several methods to measure lead concentration, based on spectroscopic properties of lead such as 'Inductively Couple Plasma Emission Spectroscopy' (detection limit 42 µg/l) and 'Atomic Absorption Spectroscopy'. These methods are the most commonly used.

There are also biosensor methods, which are based on the response of biological molecules or organisms to lead. A reporter gene system associated to a lead responding element has been used to produce a luminescent bacterial sensor for lead.[lx] A new type of biosensor for the determination of lead ions has recently been described[lxi]. 'It combines the high metal ion selectivity of catalytic DNA with the high sensitivity of fluorescence detection'. The biosensor shows an 80-fold selectivity for Pb^{2+} over other divalent metal ions, and it is sensitive to Pb^{2+} over a 10 nM to 4 µM concentration range. A plant bioassay for Al, Cd, Cu, Pb and Hg has been developed using rice as an indicator species[lxii].

Colorimetric tests are based on the development of color in the presence of lead. As described in Troubled Times[lxiii], where a team has been formed[xiv] on that subject, 'Do-it-yourself kits, are available in hardware stores to test lead in paint and ceramics[lxiv,**Error! Bookmark not defined.**]. The detection limit of most commercial lead tests is 0.25 to 0.5 ppm (0.25-0.5 µg per gram, 250-500 µg/l). The current lead level limit in drinking water in the U. S. is 0.015 ppm[xxxvi], these tests are not sensitive enough to determine whether water, food or the environment is safe. However, they can be very useful to recognize heavily lead contaminated alimentary and environmental sources.

One recommendation to the government by the committee on environmental health, 1992 to 1993[lxv], is to promote the development of a better lead test. *'There is a pressing need for a more efficient and less invasive test for lead levels or lead toxicity. The ideal measure could be used routinely on outpatients, be inexpensive, rapid, sensitive, resistant to contamination, and reliable.'*

3. 13. Lead intake in animals

Lead poisoned animals develop the same general symptoms as humans. However, the toxic threshold varies greatly from species to species. Cattle, sheep (lambs), horses, dogs and cats develop symptoms for a daily intake lower than 10 mg/kg of body weight (corresponding to 130 µg/dl in blood). Pigs, goats and rabbits are more resistant, minor signs of poisoning occur at intakes of 60 mg/kg of body weight. Poultry can withstand without symptoms, a daily dietary intake of 100 mg/kg of body weight, an intake of 500 mg/kg of body weight induces serious poisoning[lii]. Similarly to humans, higher percentage of lead is absorbed by young than by adult animals.

---

[i] Bernard J-L 'Saturnisme chronique de l'enfant' http://mtcd.timone.univ-mrs.fr/IFRAM/iframtuto/sat/SAT.htm
[ii] 'ZetaTalk®' http://www.zetatalk.com

[iii] 'Troubled Times' http://www.zetatalk.com/thub.htm
[iv] Lead Environmental Awareness and Detection L.E.A.D. 'The Chelation Controversy' http://www.webhart.net/lead/chelationcontroversy.html
[v] 'Safe Water' http://www.zetatalk.com/poleshft/p50.htm
[vi] 'Polluants' http://www.zetatalk.com/poleshft/p59.htm
[vii] 'Atmosphere Building' http://www.zetatalk.com/science/s44.htm
[viii] 'How to Prepare' http://www.zetatalk.com/poleshft/p19.htm
[ix] 'Terror Tactics' http://www.zetatalk.com/govmt/g129.htm
[x] 'Inland Lakes' http://www.zetatalk.com/poleshft/p140.htm
[xi] 'Death Wish' http://www.zetatalk.com/transfor/t28.htm
[xii] 'Nuclear Winter' http://www.zetatalk.com/poleshft/p145.htm
[xiii] 'What will Survive' http://www.zetatalk.com/poleshft/p26.htm
[xiv] 'Lead Poisoning' http://www.zetatalk.com/health/theal217.htm
[xv] 'Distillation process' http://www.zetatalk.com/food/tfood06s.htm
[xvi] 'Distilling Drinking Water' http://www.zetatalk.com/food/tfood06g.htm
[xvii] Hernberg S 'Lead poisoning in a historical perspective' Am. J. Ind. Med. (2000) **38**, 244-254
[xviii] Silbergeld EK 'Preventing lead poisoning in children' Annu Rev Public Health (1997) **18**, 187-210
[xix] Belknap EL 'Modern Trends in the Treatment of Lead Poisoning' (1961) Journal of Occupational Medicine, **3**, 380-383
[xx] Johnson FM 'The genetic effects of environmental lead' Mut Res (1998) **410**, 123-140
[xxi] Manbir Online- Lead toxicity http://www.manbir-online.com/diseases/lead.htm
[xxii] 'The Baby Boom Experiment and the Decline of Society: The Social Impact of Leaded Gasoline' http://www.webhart.net/lead/bb1-7.html
[xxiii] Sato S, Doi T & Sato J 'A temporal increase in the atmospheric 210Pb concentration possibly due to the 1991 eruption of Pinatubo volcano. An observation at Seoul, the Republic of Korea' Radioisotopes (1999) **48**, 522-529
[xxiv] Nijampurkar V & Clausen HB 'A century old record of lead-210 fallout on the Greenland ice sheet' (1990) Tellus Ser. B, **42**, 29-38
[xxv] Patterson CC & Settle, DM 'Magnitude of lead flux to the atmosphere from volcanoes' (1987) Geochim. Cosmochim. Acta **51**, 675-81
[xxvi] Kownacka L, Jaworowski Z & Suplinska M 'Vertical distribution and flows of lead and natural radionuclides in the atmosphere' (1990) Science of the total environment, 91199-91221
[xxvii] Monna F, Aiuppa A, Varrica D. & Dongarra G 'Pb isotope composition in lichens and aerosols from Eastern Sicily: Insight into the regional impact of volcanoes on the environment' (1999) Environ. Sci. Technol, **33**, 2517-2523
[xxviii] Lacroix A 'Les minéraux des fumerolles de l'éruption du Vésuve en avril 1906' (1907) Bull. Soc. Min., France, **30**, 219
[xxix] Taylor PS & Stoiber RE 'Soluble material on ash from Central American volcanoes' (1973) Geological Society of America Bulletin, **84**, 1031-1042
[xxx] Symonds RB, Rose WI, Reed MH, Lichte FE & Finnegan DL 'Volatilization, transport and sublimation of metallic and non-metallic elements in high temperature gases at Mepari Volcano, Indonesia' (1987) Geochimica et Cosmochemica Acta, **51**, 2083-2101
[xxxi] Xintaras C 'Impact of Lead-Contaminated Soil on Public Health' (1992) http://www.atsdr.cdc.gov/cxlead.html
[xxxii] 'Lead-a Toxic Element' http://www.luminet.net/~wenonah/hydro/pb.htm
[xxxiii] 'Ocean Life' http://www.zetatalk.com/poleshft/p18.htm
[xxxiv] 'Rebirth' http://www.zetatalk.com/poleshft/p02.htm
[xxxv] Gutgesell ME 'Lead screening in the general pediatric clinic' (1996) Va Med Q; **123**: 190-191
[xxxvi] Dharmananda S 'Lead Content of Soil, Plants, Foods, Air and Chinese Herb Formulas' http://www.itmonline.org/arts/lead.htm
[xxxvii] Volesky B (1989) 'Biosorption and biosorbents' in Biosorption of heavy metals, CRC Press
[xxxviii] Cazorla J 'Origines chimiques de la toxicité du plomb' Travail d'Initiative personnelle encadré http://www.eleves.ens.fr:8080/home/cazorla/tipe.html
[xxxix] Goyer RA 'Toxic and essential metal interactions' Annual Review of Nutrition (1997) 1737-1750
[xl] Goyer RA 'Lead toxicity: current concerns' (1993) Environmental Health Perspectives, 100177-100187
[xli] Kerper LE, Hinkle PM 'Lead uptake in brain capillary endothelial cells: activation by calcium store depletion' (1997) Toxicol Appl Pharmacol, **146**:127-133
[xlii] Kerper LE, Hinkle PM 'Cellular uptake of lead is activated by depletion of intracellular calcium stores' (1997) J Biol Chem, **272**: 8346-8352

[xliii] Kaminsky P, Klein M, Duc M 'Physiopathology of inorganic lead poisoning' Rev Med Interne (1993) **14**, 163-170
[xliv] Jendryczko A 'Involvement of free radicals in lead poisoning' Med Pr (1994) **45**, 171-175
[xlv] Hermes-Lima M, Pereira B, Bechara EJ 'Are free radicals involved in lead poisoning?' Xenobiotica (1991) **21**, 1085-1090
[xlvi] Monteiro HP, Bechara EJ, Abdalla DS 'Free radicals involvement in neurological porphyrias and lead poisoning' Mol Cell Biochem (1991) **103**, 73-83
[xlvii] Bechara EJ 'Oxidative stress in acute intermittent porphyria and lead poisoning may be triggered by 5-aminolevulinic acid' Braz J Med Biol Res (1996) **7**, 841-851
[xlviii] 'Intoxication professionnelle par le plomb' Institut Universitaire du travail de Rennes, http://www.med.univ-rennes1.fr/etud/med_travail/cours/plomb.html
[xlix] 'Manna from Heaven' http://www.zetatalk.com/poleshft/p70.htm
[l] 'Bone Lead: The Hidden Source' http://www.webhart.net/lead/maternal.html
[li] Taylor TM & Williams DR 'Trace Element Medicine and Chelation Therapy' The Royal Society of Chemistry
[lii] 'Lead Poisoning' http://www.ansci.cornell.edu/plants/toxicagents/lead/lead.html
[liii] Marcus S 'Toxicity, Lead from Emergency Medicine/Toxicology' http://www.emedicine.com/emerg/topic293.htm
[liv] Onalaja AO & Claudio L Genetic susceptibility to lead poisoning' Environ Health Perspect (2000) **108** Suppl1 : 23-28
[lv] 'Chelation' http://www.zetatalk.com/health/theal21b.htm
[lvi] 'Treatment Guidelines for Exposure in Children' (1995) 96, 155-160 http://www.aap.org/policy/00868.html
[lvii] Agarwal KK, Wafai ZA 'Reappraisal of heavy metal antagonists' (1985) Indian J. Pharmac 60-62
[lviii] Clark A 'Lead Toxicity in Children' http://www.nursingceu.com/NCEU/courses/lead/index.htm#pick
[lix] Martell & Smith 'Critical stability constants, Vol VI' (and previous volumes) (1989) Plenum Press, New York
[lx] Tauriainen S, Karp M, Chang W, Virta M 'Luminescent bacterial sensor for cadmium and lead' (1998) Biosens Bioelectron **13**, 931-938
[lxi] J. Li and Y. Lu "A Highly Sensitive and Selective Catalytic DNA Biosensor for Lead Ions,", J. Am. Chem. Soc. 122, 10466-10467 (2000).
[lxii] Lee PF, Huges P 'A plant bioassay protocol for sediment heavy metal toxicity studies using wild rice as an indicator' (1998) Enviro Anal., Proc. Bienn. Int. Conf. Chem. Meas. Monit. Environ., 2nd, 263-368
[lxiii] 'Lead Testing' http://www.zetatalk.com/health/theal21c.htm
[lxiv] Abotex Enterprises Limited http://www3.sympatico.ca/abotex/
[lxv] 'Lead Poisoning: From Screening to Primary Prevention' (1993) Pediatrics, **92**, 176-183.