# CONTAMINATION OF ROADSIDE VEGETATION AND SOIL WITH LEAD IN THREE TOWNS IN ASHANTI, GHANA

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## CHEMISTRY


## ABSTRACT

When roadside vegetation and soil samples from three towns in Ashanti Region of Ghana, were analysed for lead, the soil samples had larger amounts than tree barks and the tree barks in turn had greater concentrations than grass samples. The lead content demonstrated a distinct trend of distribution alongside the roads in the three towns.

The portions of the tree bark facing the roads had higher concentrations of lead than the portions facing away from the roads. The lead concentration in the tree barks, grass and soil decreased linearly with the distance from the road. The source of contamination was lead aerosols from the combustion of gasoline containing lead additives for antiknock purposes.


*Keywords: Contamination, lead, roadside, vegetation, soil*

## INTRODUCTION

The environmental importance of lead lies in its toxicity to living organisms. Lead is known to interfere in the synthesis of heme in the vertebrate body. This is due to its strong affinity for sulfhydryl group on enzymes that catalyse the formation of heme from iron and protoporphyrin and also the metabolism of - aminolevulinic acid (ALA). The result of inhibition of heme formation is the presence in the body of volumes of ALA, coproporphyrinogenin and coproporphyrin which are excreted together in urine. The levels of ALA and coproporpohyrinogen in urine may be used to diagnose the onset of plumbism.

Human activities and natural processes have been responsible for the presence of lead in the environment., Patterson [1] stated that the industrial use of lead was so massive that the amount introduced into an urban environment each year was more than 100 times greater than the amount leached from soils by streams over the entire earth. In the neighbourhood of lead smelter in Western Canada because of particulates discharged into the air, as high as 0.5 - 180.4 ppm of lead was measured in the soil [2]. The contamination decreased with distance from the smelter. Similar records were found by Burkitt et al [3], and Preston [4] in the soil in the vicinity of Bristol U.K. because of the lead-zinc smelter at Avonmouth. In countries such as U.S.A. where large numbers of automobiles are present, the atmosphere has lead aerosols due to alkyl lead additives in gasoline for antiknock purposes. Such lead aerosols contaminate soil, rivers, vegetation, crops, animals and residents nearby [5, 6].

Ghana, though not industrialized, is conscious of not contaminating her environment unduly and will have to determine the natural background levels of various elements in her environment so that any insult on the ecosystem may be detected early. But since the country started using motor vehicles as early as they were invented some of the metals added to gasoline to improve upon engine performance might have contaminated portions of the environment. It may be difficult to find a natural background for such metals. However, regular measurements at various places may help to identify when, where, and how determinations may be made. The present investigation is aimed at finding how vehicles contaminate vegetation and soil near some roads in three towns, Kumasi City, Konongo and Obuasi in the Ashanti Region of Ghana.

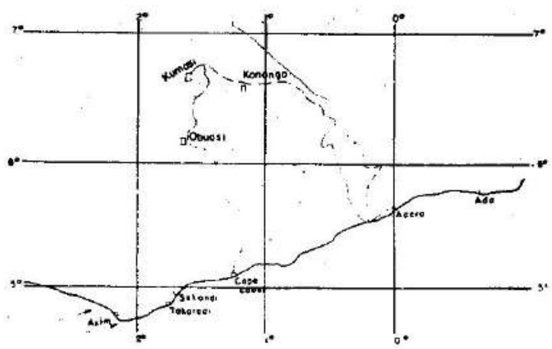


Fig.1 Map showing the towns sampled and direction of the wind

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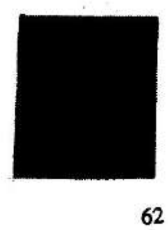

# AIDS IS REAL

AIDS (Acquired Immune Deficiency Syndrome) is a new and devastating infectious disease sweeping through the world in a massive tidal wave of misery and death. AIDS was first recognised in the U.S.A. in 1981 and the causal organism thereof, a retrovirus, was identified in 1983 and named Human Immunodeficiency Virus (HIV).

AIDS is a disease that causes gradual weakening of the immune system so that the body is no longer able to fight off infections. HIV-infected individuals may look perfectly healthy for many years while the virus continues to multiply in their blood and in certain tissue cells. Infected persons may, however, eventually become ill, often with different otherwise innocuous microorganisms, and tumours. The average time lag between HIV infection and the first appearance of disease, the incubation period, is long (eight to ten or more years) in adults but it is much shorter in infants and children. Once an HIV-infected person develops full-blown AIDS he/she will surely die within two years, after having had milder forms of intermittent disease for a considerable length of time, which latter situation is called the AIDS-RELATED COMPLEX (ARC). HIV-infected individuals without any signs or symptoms, at all, of disease are called Healthy Carriers. These togeher with those having ARC as well as those with full-blown AIDS are highly infectious to others through unprotected sexual intercourse, blood and blood products and transplacentally from mother to child.

There is as yet no effective vaccine developed against AIDS nor has a cure for it been found despite the unpresidented global efforts being made in these directions.

It is to be realised that AIDS is not contracted through living and playing together, eating or shaking hands with HIV-infected persons. Moreover, the virus is not spread by food, water, communion cups, insect bites or through contaminated toilet seats. The virus is so labile it does not survive outside the body.

In the absence of a vaccine against AIDS or a cure for the disease, the only remedy to the current rapid spread of AIDS, therefore, lies in the adoption of positive attitudinal and behavioural change on the part of all. However, those who are already HIV-infected may help prevent further spread of AIDS by sticking to one sexual partner and using the condom.

The HIV-infected/AIDS patient is harmless to society as long as society does not use, for any purpose whatsoever, blood or blood products from him/her, have unprotected sexual intercourse with him/her, so there will be no resultant pregnancy with the inevitable in utero foetal infection nor share razor blades, tooth brushes and injection needles. It is rather the "healthy" members of society who are a threat to the survival of the HIV-infected/AIDS patient. He/she is highly vulnerable and may even die "prematurely" through infection by the common cold virus (Rhinovirus) contracted from a friend with a cold. The HIV-infected/AIDS patient requires and deserves society's protection and empathy just as the victim of poliomyelitis or cerebrospinal meningitis (CSM) or river blindness (Onchocerciasis). It is society's bounden duty to help prolong the life of the unfortunate (unfortunate in the sense that AIDS knows no King, President, begger, Bishop, the upright or the truant) HIV-infected/AIDS patient. This may be accomplished by offering the patient unbridled social support and empathy and not sympathy. Empathy and social support are two pillars upon which the survival or longevity of the HIV-infected/AIDS patient rests.

AIDS is real in our society and it must be recognized as such.

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## MATERIALS AND METHODS

Samples of bark of trees, grasses and soil were collected from roadsides on roads in Kumasi City, Konongo and Obuasi in triplicate. The Fig. 1 is a map showing these towns in the Region. The roads sampled were Duncanson Road U.S.T., Kumasi (UST) Guggisberg Road, Adum (Adum Kumasi), Accra-Kumasi Highway in Konongo. The position of the trees dictated the sampling points. It was not planned to sample at nearly equal distances. The barks were from Mangifera indica (Lin) and Peltophorum pterocarpum (Backer). The grasses sampled were Sporobulus pyramidalis (P, Beauv), Eleusine indica (Gaertn) and Chrysopogon aciculatus (Trin). Wherever practicable a set of samples of tree barks, grass and soil was collected in triplicate on the same site and put in separate poly ethylene bags.

Two different sets of tree barks were taken from the same tree. A set was collected from the portion of the tree facing the street or road and labeled as F and another set from the same tree on the side facing away from the road was taken and designated as A. These were put in different bags and labeled appropriately. The distance of the tree from the edge of the road was measured and recorded. The grass samples were collected from the same neighbourhood. The distances of the grasses from road were also taken. Soil samples were collected by making small hole in the earth and the first 5 cm of soil was collected and intimately mixed.

In the laboratory the bark and soil samples were put into petri dishes and dried in the oven at 110°C to constant weight. The grass samples were freed of extraneous matter and dried in the oven at 110°C to constant weight. The tree barks were ground to fine powder in a mortar with a pestle. Three separate 1g powder was put in three separate boiling tubes and digested in 20 mL of concentrated AnalaR $HNO_3$ over a hot plate in a sand bath, for 30 min. The mixture was allowed to cool and 3 mL of 70-72% $HCLO_4$ and boiling chips were added and the solution boiled gently for 2 h. The heat was removed and the solution allowed to stand in the fume cupboard over night. The solution was then filtered with Whatman No.41 filter paper and made up to 100 mL mark in a 100-mL graduated flask with double distilled water. This solution was put into a glass bottle and set aside for analysis in an Atomic Absorption Spectrophotometer (AAS). The grass samples were similarly treated.

To 1g of dry soil sample were added 5 mL of double distilled water and 20 mL of concentrated AnalaR $HNO_3$. This mixture was stoppered tightly and allowed to stand in the fume cupboard overnight. The mixture was boiled for 1 h and allowed to cool. After cooling 5mL of 70-72% $HCLO_4$ and boiling chips were added. The mixture was gently heated to boil for 30 min and allowed to cool. After cooling another 5 mL of double distilled water was added and then boiled for 2 h. It was then cooled, filtered and made up to 100- mL mark in 100-mL graduated flask. This final solution was transferred into a bottle and stoppered to await analysis in the AAS.

For each sample collected at least three different portions were prepared for analysis. Thus the reported levels was a mean of 24 samples each of which was treated in triplicate.

The treated samples were analysed in Atomic Absorption Spectrophotometer "AAS 3" for lead by using the appropriate standard solutions and the lead hollow cathode lamp. Samples were collected once a week for a period of 8 weeks (March and April, 1990). At each point 3 different sets of samples were collected on both sides of the roads. The means for each set of 24 samples per point were calculated and used in the Tables and graphs.

## RESULTS AND DISCUSSION

Since the sampling period was not long, there was no distinct variation with the weeks. The variation observed were looked upon as distribution about the means. If sampling had been carried out for a much longer period distinct trends might have emerged with the weeks, months or seasons. Sampling for longer periods and longer distances is my next line of approach to confirm the pattern of distribution.

**Table 1: Levels of lead in ppm in tree barks collected from alongside Duncanson Road on UST campus in March and April, 1990**

| Distance from Edge of Road | Pb F.W. | Pb A.W | Tree |
|---|---|---|---|
| 1.5 m | 31.32 | 17.91 | Peltophorum pterocarpum (Backer) |
| 2.5 | 29.86 | 17.70 | " " " |
| 3.5 | 24.16 | 16.90 | Mangifera indica (Lin) |
| 4.0 | 21.72 | 16.12 | " " " |
| Corr. coeff. | 0.893 | 0.936 | |
| | F.E. | A.E | |
| 1.5 | 38.30 | 19.25 | Peltophorum pterocarpum (Barker) |
| 2.5 | 36.85 | 18.62 | " " " |
| 3.5 | 32.86 | 17.92 | " " " |
| 4.0 | 29.03 | 16.85 | " " " |
| Corr. Coeff. | 0.911 | 0.932 | |

E, W stand for Eastern and Western sides of the road.
F, is for portion of the tree facing the road.
A, is for portion of the tree facing away from the road.
Corr. coeff. is correlation coefficient.

A typical pattern of distribution of lead is shown in Tables 1-3. In the bark the portion of the trees facing the roads had higher concentration of lead than the portion facing away from the roads, Table 1. The amounts in the bark decreased with increasing distance on both sides of the roads, (see correlation coefficients in Table 1). Even when the amounts in the barks of the three different species of trees were compared the pattern was little affected. In Table 1, Peltophorum species were found on the Western sides, F.W., A.W. at distances up to 2.5m and Mangifera species were present beyond 2.5 m and these were sampled to make up for the remaining two positions. Even in this context the trend was not interfered with. This seems to suggest that the amounts of lead in the bark was mainly adsorbed forms which came from the atmosphere. If the amounts were from the amount absorbed from the soil, there might have been species variations dependent on the preferences of the various tree species and the amounts in the soil. The concentrations of lead in the barks were higher in samples in the direction of the prevailing wind than in the opposite direction.

**Table 2: Levels in ppm of lead in grasses sampled alongside Duncanson Road on UST campus Kumasi in March and April, 1990**

| Distance from Edge of Road | Pb Western | Grass |
|---|---|---|
| 1.5 m | 17.42 | *Eleusine indica* (Gaertn) |
| 2.0 | 16.99 | " " " |
| 2.5 | 15.83 | " " " |
| 2.8 | 15.02 | *Chrysopogon aciculatus* (Trin) |
| 3.0 | 14.52 | " " " |
| 3.5 | 13.31 | " " " |
| 4.0 | 12.48 | " " " |
| 4.2 | 11.17 | " " " |
| Corr. coeff. | 0.911 | |
| | Eastern | |
| 1.5 m | 19.94 | *Eleusine indica* (Gaertn) |
| 2.0 | 17.83 | " " " |
| 2.5 | 17.11 | " " " |
| 2.8 | 16.65 | *Sporobolus pyramidalis* (P.Beauv) |
| 3.0 | 15.45 | " " " |
| 3.5 | 14.54 | " " " |
| 4.0 | 12.22 | *Chrysopogon aciculatus* (Trin) |
| 4.2 | 11.84 | |
| Corr. coeff. | 0.899 | |

Corr. coeff is correlation coefficient.

**Table 3: Level in ppm of lead in soil samples collected from alongside Duncanson Road UST campus, Kumasi in March and April, 1990**

| Distance from Edge of Road | Pb | |
|---|---|---|
| | Western | Eastern |
| 1.5 m | 60.90 | 88.78 |
| 2.0 | 56.88 | 79.82 |
| 2.5 | 52.66 | 75.65 |
| 2.8 | 50.78 | 71.50 |
| 3.0 | 49.98 | 64.07 |
| 3.5 | 47.98 | 60.98 |
| 4.0 | 45.97 | 50.54 |
| 4.2 | 45.88 | 46.82 |
| Corr. Coeff. | 1.077 | 0.8831 |

Corr. coeff. is correlation coefficient.

The amounts of lead found in the grass (Table 2) also decreased with distance irrespective of the species of grass on both sides of the roads. This again lends support to the supposition that the measured lead was mainly adsorbed forms on the grasses. The levels of lead in samples in the direction of the prevailing wind were again higher than those in the opposite direction.

The surface soil samples nearest the edges of the roads had bigger amounts of lead than the portions further away from the roads, Table 3. The levels of lead also decreased with distance on both sides of the roads. Samples from the direction of the prevailing wind had higher concentrations of the metal than those from the opposite direction. The surface soil samples also had stronger concentrations than the grass. For example at Adum in Kumasi City, the surface soil lead was between 98.91 and 148.86 ppm, the barks had between 40.96 and 77.17 ppm and the grasses ranged from 42.98 to 52.86 ppm. This might be due to the fact that the surface soil seemed to store amounts deposited on it and those from decaying leaves and grass. Another possible reason why the bark had higher concentrations is that the surfaces of the barks were such that they adsorbed the lead particles more strongly than the grass surfaces. Since the amounts of lead in the various samples decreased with distance on both sides of the roads the sources of lead was from activities taking place in the roads. The main processes in the roads which could be responsible for generation of lead were the combustion of leaded gasoline in petrol engines. The petroleum refinery in Ghana adds about 0.6% of tetraethyl lead to gasoline for antiknock purposes.

**Table 4: Ranges of levels of lead in ppm measured on the roadsides in the various towns in various samples**

| Sample | UST Duncanson Road | Kejetia/Adum Guggisberg Road | Konongo Accra-Kumasi Highway | Obuasi Kumasi-Obuasi Highway |
|---|---|---|---|---|
| Soil | 46-89.40 | 98-148.86 | 35-90.10 | 50-75.42 |
| Bark | 16-31.21 | 40-77.17 | 35-70.23 | 18-25.36 |
| Grass | 11-19.41 | 42-52.86 | 20-45.34 | 10-20.21 |

Samples from Kejetia, Kumasi City centre had the largest amounts of lead, see Table 4. This was because the City Centre had the largest volume of traffic and the speed was not high in this area. Konongo samples contained the second highest amount of lead and the third position was taken by Obuasi samples. The UST samples had the least. Even though the highway through Konongo had faster moving vehicles the speed of the vehicles might have thrown the aerosols to further distances and hence lesser amounts measured in the proximity of the road. Though the Kumasi-Obuasi road is also a highway, the number of vehicles and the speed through Obuasi might be less and hence lesser amounts of lead aerosols in the vicinity of this road than in Konongo. It is not surprising to find the least on UST campus because there is lesser vehicular movement. It is highly probable that if longer distances could be sampled there might be total absence of lead aerosols at a definite distance from roadside on the campus.

The variation of the amounts of lead in the samples are illustrated by Figs. 2 to 4. The decrease was linear with increase in distance from the edges of the roads. The nearly perfect linearity shown seems to suggest that the natural amounts of lead present in the soil and those absorbed from the soil by the trees and grasses were so small that they did not interfere with the amounts adsorbed as results of the combustion of leaded gasoline in the roads. This supports the fact that industrially produced lead is many times greater than natural amounts in the soil [1]. The linearity observed in the present investigation is contradictory to the exponential pattern observed by Gish et al [5]. This discrepancy could be due to the fact that samples were not taken from longer distances in the present investigation and hence only the linear portion of the exponential curve was examined. Longer distances will be needed to confirm whether there was a discrepancy or not. And that at longer distances other factors may interfere and hence the exponential pattern. It should however be noted that during above cited experiment other elements like zinc displayed linearity and the explanation was not obvious. Gish et al [5] examined the lead adsorbed by earthworms but the present investigation deals with adsorbed lead on surfaces. The present measured lead could be regarded as made up of mainly larger aerosol particles which settled near the roads. This is certainly in agreement with the findings by Chow [7] who showed that large particles were carried to shorter distances whereas the lighter and finer aerosol particles remained in the air and were carried to longer distances until they fell to the earth in precipitation.

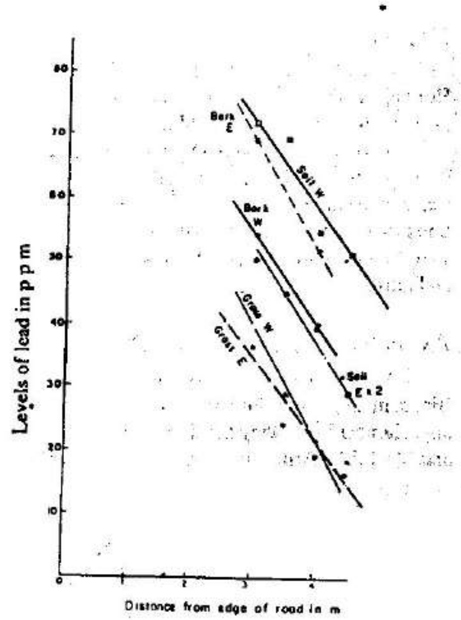


Fig.3 Variation of lead with distance in various samples alongside Accra-Kumasi Highway in Konongo. E,W. stand for Eastern and Western sides of the road.

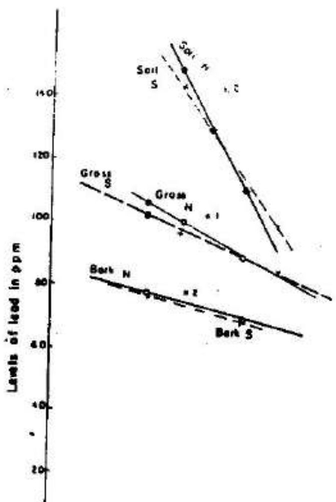


Fig.2 Variation of lead with distance in various samples alongside Guggisberg Road at Adum/Kejetia, Kumasi. N,S stand for Northern and Southern sides of the road

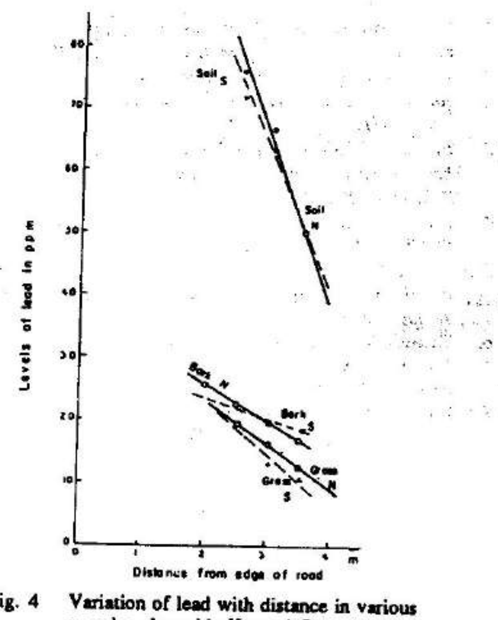


Fig. 4 Variation of lead with distance in various samples alongside Kumasi-Obuasi Highway in Obuasi N,S stand for Northern and Southern sides of the road.

Since lead contamination decreased with distance there will be a distance after which vehicular lead aerosols, at least the type which produced the linearity, may not be detected. This is being investigated because it will be of interest to those who may wish to measure the natural background levels of this metal in the environment.

## CONCLUSION

Roadside vegetation and soil in Kumasi City, Konongo and Obuasi were contaminated with lead from the combustion of leaded gasoline in petrol engines. The amounts of lead in vegetation and soil decreased with distance on both sides of the roads. The portions, of the roads in the direction of the wind had higher concentrations of lead than the opposite direction. Surface soil samples had higher levels of lead than the bark of trees and grass.


## ACKNOWLEDGEMENT

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# LIBRARY INSTRUCTION AT THE UNIVERSITY OF SCIENCE AND TECHNOLOGY(U.S.T.): A NEED FOR NEW APPROACHES

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## ABSTRACT

Instruction in library use is a persistent problem. This is revealed by the welter of writing and the extent of interest in the subject.

Now than before, bibliographic instruction stands at the cross roads of the 'information explosion'. This may, in part, be due to the accelerated volume of published information particularly in science, medicine and technology. To cope with the ever-increasing volume of knowledge, students need to comprehend the methods of information retrieval.

The UST stands out as the only university in Ghana that offers courses in technology in addition to science and medicine - all being disciplines where instruction in library use is paramount. Based on empirical research, this article focuses on the library instruction programme for freshmen at the UST and highlights its deficiencies. Recommendations are made for the improvement of the programme to make it comprehensive and effective


*Keywords*
*Library orientation, User education, Bibliographic instruction, User instruction, Library instruction, University of Science and Technology*

## INTRODUCTION

Library orientation and user or bibliographic instruction are often used interchangeably. The two are collectively referred to as user education. Traditionally, whenever either is used it is taken to mean instruction in library use. That is, the development of a pattern of habits that will lead the individual to information sources.

Instruction in library use is a persistent problem. For several decades, librarians and library researchers have been concerned with the need to teach readers how to use libraries effectively. But this effort is most often hampered by inadequately drawn orientation programme, lack of resources, absence of co-operation between library staff, faculty and students. For instance, whilst the library staff may be primarily concerned with the maximum utilization of the information resources possessed by the library, faculty and students may exhibit gross lack of commitment to the programmes. The latter, in addition, may only want to know how to find information, as quickly as possible in order to pass examinations. This diversity makes it difficult to integrate the varied needs of the three groups to offer a meaningful orientation.

One other problem is that libraries differ in sizes, and their operations as well as services provided may change. Above all, a change in the enrolment of students for a particular academic year may lead to a review of the orientation programme, the resources and teaching strategies. Thus, instruction in library use may vary from year to year and may have to be reviewed periodically. It is not something that could be taught once and for all. It is a continuous process. These recurring problems explain why the subject has generated much interest and diversity of coverage given it in writing, studies, surveys conferences and seminars by libraries and researchers to explore the best ways to maximize scanty resources and to find better ways to teach user education programmes.

## HISTORY

Raseroka traces the roots of instruction in library use further back and observes that:

> The literature on the need and importance of bibliographic instruction in academic libraries extends from the period libraries were identified as educational agencies.[1]

In fact, the first formal attempt at instructing college or University students in the use of the library began at the University of Michigan where its first librarian, Raymond C.Davis for three years gave instructions to students. A more serious approach to this started in 1882 when the Board of Regent of the University established

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