LEAD Action NEWS

LEAD Action News is the journal of The Lead Education and Abatement Design (LEAD) Group.

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Editorial

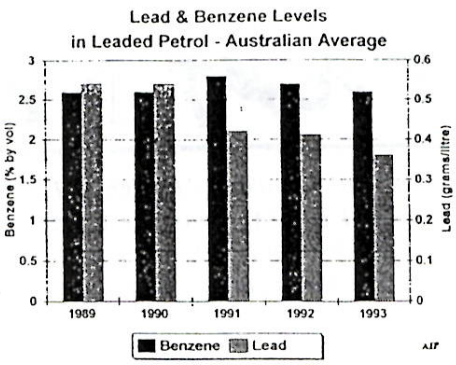
Benzene Scare Campaign Tackled Head-on

A scare campaign over the last couple of years has attempted to convince the public and legislators that reducing the amount of lead in petrol will result in increased levels of benzene in petrol because benzene is the cheapest alternative octane enhancer, *and that this has already happened in Australia.*

The benzene content of leaded petrol may have increased in other countries as the lead has been reduced but to The LEAD Group's certain knowledge, the benzene content of leaded petrol in Australia has **not** increased as lead has been decreased, in the period 1991, when The LEAD Group was set up, to the end of 1994 (see graph overleaf).

Benzene, which is a natural component of crude oil, is permitted in Australian petrol up to a maximum of 5 per cent. The normal range for Australian petrol is between 2.5 and 3%. The rumour being put about is that refineries have taken the option of raising the benzene content up to the permissible 5%. *P.T.O.*

Editorial Cont'd.



This has not happened between 1991 and 1993 as the graph shows. To ensure that it does not happen in the future, The LEAD Group will be calling for a legislative limit on permissible benzene, at certainly no higher than 3%.

But wait: as Demtel says, there's more. The lead additive industry is a hydra-headed monster of great vigour. Another of its rumours is that unleaded petrol contains more benzene than leaded. Not true. They are about the same - that is, between 2.5 and 3%. To make leaded petrol, the refiners (other than Shell) tell us that they simply add lead to low-octane unleaded petrol.
The benzene content of unleaded petrol **has** been increased in certain countries, such as Britain, because of - in Britain's case - a commitment to high-octane unleaded petrol. In Britain, when a car switches from using leaded petrol to using unleaded there is only high-octane high-benzene unleaded available. In Australia, drivers of pre-1986 cars have a choice between low-octane unleaded (now over 50% of petrol sales) and high-octane unleaded (less than 1% of petrol sales) which virtually no-one buys because of the outrageous price differential (7-15 cents per litre).

Benzene in Australian petrol has been going down since 1991, together with the reduction in lead - a possible reflection of the refining industry's concern with the supposed causal link between benzene in motor vehicle emissions and childhood leukaemia. The accepted link between benzene and cancer occurs at occupational exposures to benzene around 5000 times the concentration found in motor vehicle emissions.

A smoker, or a child living with a smoker, will get most of their exposure to benzene from the cigarette smoke. If producers of tetraalkyl lead (petrol additive) were serious about reducing benzene exposure they would join the anti-smoking lobby, as The LEAD Group has done.

The lead industry has attacked Professor Herbert Needleman's 1979 study as to the effects of low-level lead exposure. Professor Needleman's findings have been confirmed and the attacks laid to rest, yet the lead additive industry continues to refer to the research as though it were in doubt. (See article opposite).

Other research increasingly implicates particulates in being a major cause of deaths and respiratory disease linked to motor vehicle emissions. Lead is a significant component of particulates in our cities. See p 4 of this LEAD Action News.

One thing the lead additive manufacturers don't ever mention is that the lead scavengers which must be added to leaded petrol in order to scavenge the lead from the engine, are also linked with cancer, and that the concentration of dioxin (a known carcinogen) is higher in leaded petrol motor vehicle emissions than unleaded emissions as a result of the addition of these lead scavengers. (See Dr Winder's article on p 9.)

Another claim is that when the amount of lead in petrol is reduced, there is no difference in people's blood lead levels. Not true. US National Health and Nutrition Examination Surveys (NHANES) found a decline in blood lead levels closely correlated to a decline in lead in petrol. See the abstract of the latest NHANES results on p 8. of this issue of LEAD Action News. And research from Italy found that lead from petrol contributed around 30% of people's lead in blood (see p 7.). Children living near busy roads have higher tooth lead levels according to Danish research (see p 6).

Of course we acknowledge that there are other sources of lead besides petrol. Refer to the Total Environment Centre's lead fact sheet (phone TEC on (02) 247 4714), and refer to the letter on p 12 of this LEAD Action News.

By plain truth is that there's over 1000 toxics in petrol - leaded or unleaded. The only answer is to use less of it! That's why we're publishing extracts from the Total Environment Centre's policy on car use reduction - see p 9.)

We haven't killed the monster - it's in the nature of a Hydra (a creature in Greek Mythology) - that they grow new heads as soon as the old ones are cut off. But we hope we might have slowed it down a bit! (We'll cut off a few more heads in the next issue of LEAD Action News.)

Lead Industry Accusations Don't Hold Water

by The Alliance to End Childhood Lead Poisoning

Summary of US Department of Health and Human Services Review of Needleman Study: Final Report by the Office of Research Integrity

Central ORI Finding: No Scientific Misconduct

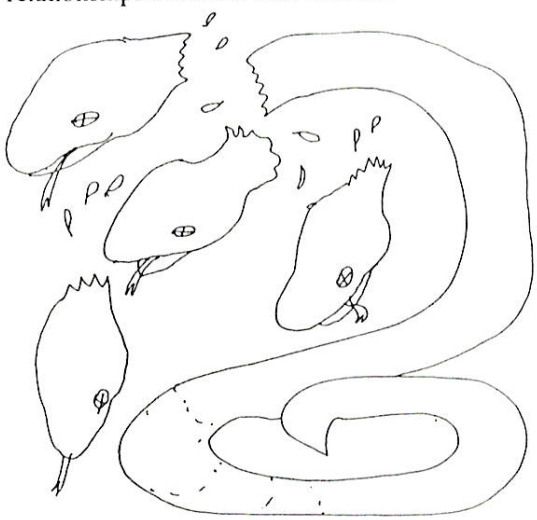
The US Department of Health and Human Services (HHS) Office of Research Integrity (ORI) recently concluded its review of charges brought by scientists with connections to the lead industry against Herbert L. Needleman, M.D., a leading researcher. ORI found **no scientific misconduct** in Needleman's research, concurring with the University of Pittsburgh Hearing Board which conducted the first phase of the investigation.

Other ORI Recommendations

ORI criticised a few methodological and reporting issues and requested Needleman to submit corrections and clarifications to the appropriate scientific journals.

Hazards of Lead Poisoning Confirmed

Despite the methodological discrepancies noted, **ORI confirmed Needleman's principal findings of a lead effect on IQ.** In addition, ORI reported that confirmatory analyses of his original data were separately performed by the University of Pittsburgh's Hearing Board and by Joel Schwartz, Ph.D. of the US Environmental Protection Agency (in an analysis published separately). Both analyses confirmed - or suggested even stronger - relationships between lead and IQ.



Scientific Research Justifies Stronger Prevention Policies

There is no dispute with Dr. Needleman's conclusion that lead poisoning poses a grave danger to children. Since Needleman's 1979 study was completed more than a dozen researchers from the U.S. and around the world have documented lead's adverse effects at lower and lower levels. Indeed, a National Academy of Sciences report issued last October concluded that:

"The weight of evidence gathered during the 1980s clearly supports the conclusion that central and peripheral nervous systems of both children and adults are demonstrably affected by lead at exposures formerly thought to be well within the safe range. In children, blood lead concentrations around 10 μg/Dl are associated with disturbances in early physical and mental growth and in later intellectual functioning and academic achievement." (National Academy of Sciences (NAS), National Research Council, "Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations", 1993, p. 93)

In fact, the steadily accumulating action to protect our children from lead poisoning is more urgent than ever. The scientific debate over lead's toxicity is over, and it is pointless and distracting to delay action further. It's time to devote our energies to protecting children. Every lawmaker who cares about children's health and development should support measures to regulate inappropriate uses of lead, routinely screen young children's blood lead levels, and increase resources to abate serious lead hazards.

Acknowledgments

Elizabeth O'Brien (Editor) sincerely thanks the following people for their invaluable contributions:

Noela Whitton, Greg Jewson, Anne Roberts, Cathy Jin, David Ratcliffe, Desktop Workshop, Theresa Gordon, Herbert Beauchamp, Dr Garth Alperstein, Dr Chris Winder, Augustina Jones, Steve Shamoes, Alexander Claud, Cathy Wilcox, Laura Spinney of New Science Press (publishers of New Scientist), James Rochow and the Alliance to End Childhood Lead Poisoning (US).

Death Comes in an Invisible Chemical Soup

by Julian Cribb

Reprinted from The Weekend Australian

Lung disease and premature deaths in our cities may be due to a previously unrecognised threat in the air we breathe.

Blinding headaches, asthma attacks, mysterious rashes and abdominal lumps, memory loss and deep fatigue are the legacy of the Gulf War for thousands of soldiers who served there, rapidly becoming as recognisable as Agent Orange symptoms were to an earlier generation of servicemen.

But to Dr Arthur Tucker the signs looked all too familiar. He'd seen them before when he was chief medical officer at the nuclear facility at Lucas Heights in the 1960s. The same symptoms have been reported among miners, industry workers and increasingly, the general urban population.

Nobody was interested then, and few are now, in the theory which Dr Tucker developed: that many people suffer from extreme sensitisation caused by multiple exposure to chemical particles so minute they cannot be seen by any but the most advanced equipment - grains of poisonous metals only a few atoms in dimension.

Evidence that Dr Tucker may have pinpointed the source of one of the greatest plagues afflicting modern society is rapidly accumulating.

Drifting in the air above our cities is an invisible pall of microscopic particles. Over Sydney alone, a thousand tonnes of lead from exhaust emissions hangs in the atmosphere daily, too light ever to sink to earth but constantly breathed in and out by every gulping motor, and by every inhabitant.

Up to one third of airborne pollution may consist of ultrafine particles, measuring from 330 billionths of a metre in diameter to objects vanishingly small - vastly tinier than smoke particles and totally invisible.

Conventional medical theory holds such ultrafine particles are far too minute to linger the lungs or to be absorbed into the blood supply, let alone to affect the body. They therefore ought to have no effect on us.

That was until Dr Bill Burch, at the John Curtin School of Medical Research, achieved one of the outstanding world-firsts of recent Australian science - the discovery and first application of the buckeyball, a novel carbon molecule, for medical imaging.

Dr Burch found that a vapour consisting of buckeyball molecules, measuring only 10 billionths of a metre across (10nm), was readily absorbed through the lungs and into the bloodstream. For his purposes, this made it ideal, if linked with a radioactive particle, for radio imaging of the body.

In the process he provided evidence that what Dr Tucker had been asserting for the better part of three decades was accurate - that ultrafine particles can get inside us via the lungs, the capillaries and bloodstream, with unpredictable effects. Those effects are liable to be magnified if the particles of certain metals have been heated or if they combine with other chemicals.

The symptoms of this peculiarly subtle form of poisoning are many and varied. Dr Tucker says: rashes, nausea, changes in red or white blood cells, bleeding in the lungs or gut, malfunction of spleen or liver, breathing difficulties, nervous degeneration, weakness and lassitude.

Dr Tucker is a stubborn, unrelenting man. A former World War II fighter pilot, he went on to become principal research scientist and site medical officer at the Australian Atomic Energy Commission (now ANSTO) at Lucas Heights. There he encountered six cases of a mysterious and incurable lung disease, sarcoidosis. Probing into these, the authorities were inclined to attribute them to exposure to radioactive material but Dr Tucker disagreed.

Based on studies of industries with high levels of sarcoidosis, he concluded the disease was probably triggered by the inhalation of minute particles of heat-activated uranium, beryllium or styrene - materials frequently handled at the AAEC. Another case came from Melbourne University of a researcher exposed to heated scandium.

The medical literature threw up a number of highly suggestive parallels - workers making early

fluorescent tubes suffered from a disease called berylliosis, caused when the beryllium-coated tubes were baked, then reamed, releasing an invisible dust of ultrafine, oxidised particles. Another disease, Shaver's disease, occurred among Canadian crane drivers working in fumes of heated bauxite in an aluminium plant. Uranium miners also showed a high level of sarcoidosis although it was usually wrongly diagnosed as TB.

The reason the diseases went undetected, Dr Tucker says, is that doctors, not knowing of their existence, simply assumed a well-known cause, such as radiation at Lucas Heights, and carried out the wrong diagnostic tests.

Then came Gulf War Syndrome. Among the many possible causes of lung complaints and chemical sensitisation among thousands of veterans one stood out: the use by the US forces of depleted uranium to make ultra-heavy armour-piercing shells and tank armour.

During the colossal temperatures generated when a shell punches into its target, a cloud of ultrafine metallic oxides is given off, drifting like a fog across the battlefield.

"It's invisible. You cannot see it. Many doctors and scientists are simply unaware of the possibility. They cannot believe that particles they don't know about could be causing these diseases," Dr Tucker says.

Dr Burch said it was the thought of the pall of lead drifting over our cities that persuaded him of the risk and that Dr Tucker might be on to something.

"If you can suspend 1000 tonnes of lead over Sydney, you can suspend anything provided it is small enough," he says.

But the lead, and all the other chemical and metal particles, are not merely being suspended. They are also being sucked in by a million engines, super-heated, then spat back in to the air we breathe - again and again, many times a day. What toxic witches' brew is formed in this process nobody can say.

Dr Tucker tested his theory on lab rats suffering from kidney disease on a certain diet. Study of the diet revealed it contained ultrafine food particles, and it was the inhalation of these, not their digestion, which produced the disease. Changing the diet quickly got rid of the problem.

He also demonstrated a fluid mechanism, previously rejected by medical scientists, by which the particles could pass out of the lung capillaries into the blood stream. Dr Burch's radio-imaging research has confirmed this.

"Airborne particles have been forgotten since most big cities won the smog war back in the 1960s. Because we can no longer see them, we don't worry about them," Dr Tucker says.

"And many of these particle-caused diseases are being diagnosed as simply asthma, emphysema or allergies when in reality we are dealing with multiple chemical sensitisation.

"That sensitisation can cause rashes, changes in blood circulation, nausea, bleeding, liver problems, breathing difficulties and nervous degeneration."

It is ironic that medical science may have overlooked one of the most damning pieces of evidence, Dr Burch believes.

One of the symptoms of the condition is reduced blood flow in the lungs but if you x-ray someone who has reduced blood flow, the image comes up clear because less blood is present. The x-ray looks "clean".

Dr Burch found 30-40 per cent of Canberra residents he studied had abnormal lung blood flow. Overseas colleagues in the Netherlands city of Utrecht and Liverpool in England reported 70-80 per cent of patients had lung defects.

Damaged lungs may, in other words, be far more common among city dwellers than previously suspected, simply because the most common test reveals victims as "clear".

Indirect support for their view may exist in the epidemic of asthma and other bronchial diseases in Australia. More than 14,000 Sydney residents died of lung diseases between 1981 and 1988, according to a study by Macquarie University's Professor Peter Cursor.

"An unacceptable proportion of these deaths were untimely or premature," he said in a recent report. Thirty-seven per cent of deaths occurred in people aged less than 60 years.

Professor Cursor also noted a distinctive regional

pattern, with concentrations in the inner city and outer west - the two areas where pollution is most persistent.

He attributes the problem to a multiplicity of causes - air pollution, sick buildings, allergens, climate and season - but notes the relationship between cause and effect is not well understood.

Earlier this year a report in the journal New Scientist said that unpublished British Government data estimated 10,000 Britons a year were dying as a result of fine particles in exhaust fumes. These particles were in a category called PM10, meaning they were particulate matter smaller than 10 micrometres (millionths of a metre) across.

Originally dismissed as harmless, recent US studies have caused the British Government to re-evaluate the risk of ultrafine dust. Both British and US research has now revealed a strong link between increases in PM10 levels and respiratory death rates although the exact pathway has not yet been made clear.

"The point is that we're getting the same class of diseases from a wide range of these ultrafine substances," Dr Tucker says. "But because of the tendency of science to focus on one particular cause, we're not seeing the forest for the trees. What is so important is the pathway into the body, not the precise chemical content.

"It is the whole invisible chemical soup in the air of our cities we should be concerned about."

(c) The Weekend Australian

tips and FACTS

Some facts from the clean air promotion by CEPA (Commonwealth Environment Protection Agency)

1 The average rate of increase of motor vehicles over the last 30 years was 5.2% per annum, which is more than twice the rate of growth of global population. There are now 430 million motor vehicles on earth - increasing by 9.5 million each year.

2 The Inter-State Commission estimated that, on the basis of health costs and property damage, the cost of air pollution each year in Australian cities alone is $780 million.

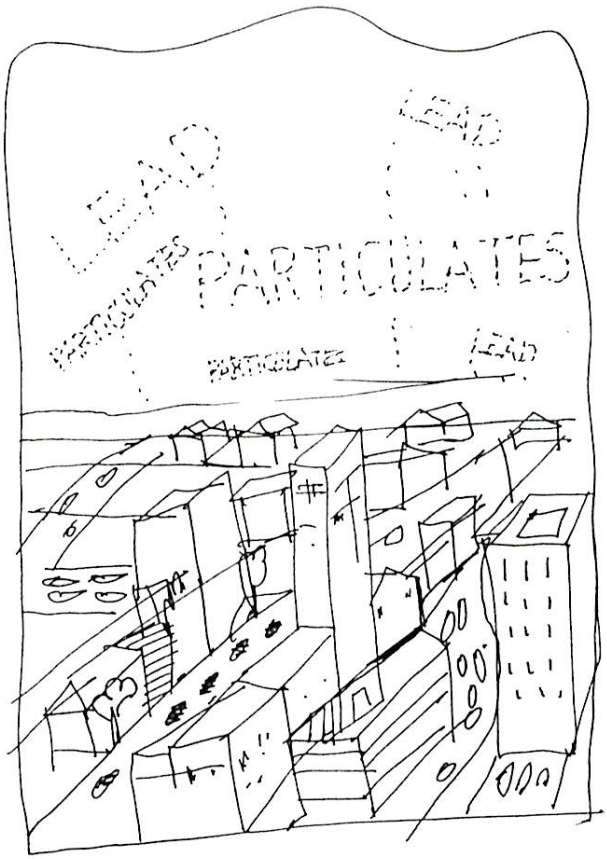
Predictors of Tooth-lead Level with Special Reference to Traffic

by Troels Lyngbye, Ole N. Hansen and Philippe Grandjean

A study of lead-exposure in children

Reprinted from the International Archives of Occupational and Environmental Health (1990) 62:417-422 Springer-Verlag 1990

Summary: Possible predictors of the lead burden of children were investigated in a low-exposure area. A total of 1302 school children in the first form within the municipality of Aarhus, Denmark, donated deciduous teeth for determination of the lead concentration in the circumpulpal dentin. The families were interviewed in possible sources of lead. Present and former addresses of residences and day-care institutions were obtained, and the traffic intensity was estimated at each of these addresses. Children with a high lead burden resided significantly more often in heavily-travelled streets than children with a low burden, but only during their first 3 years of life. The increased risk for a high lead burden was related to the traffic intensity in a dose-response manner.



A Clear Case Against Lead in Petrol

by Lawrence McGinty

The following is an extract from an article in New Scientist 27 May 1982, Monitor Section

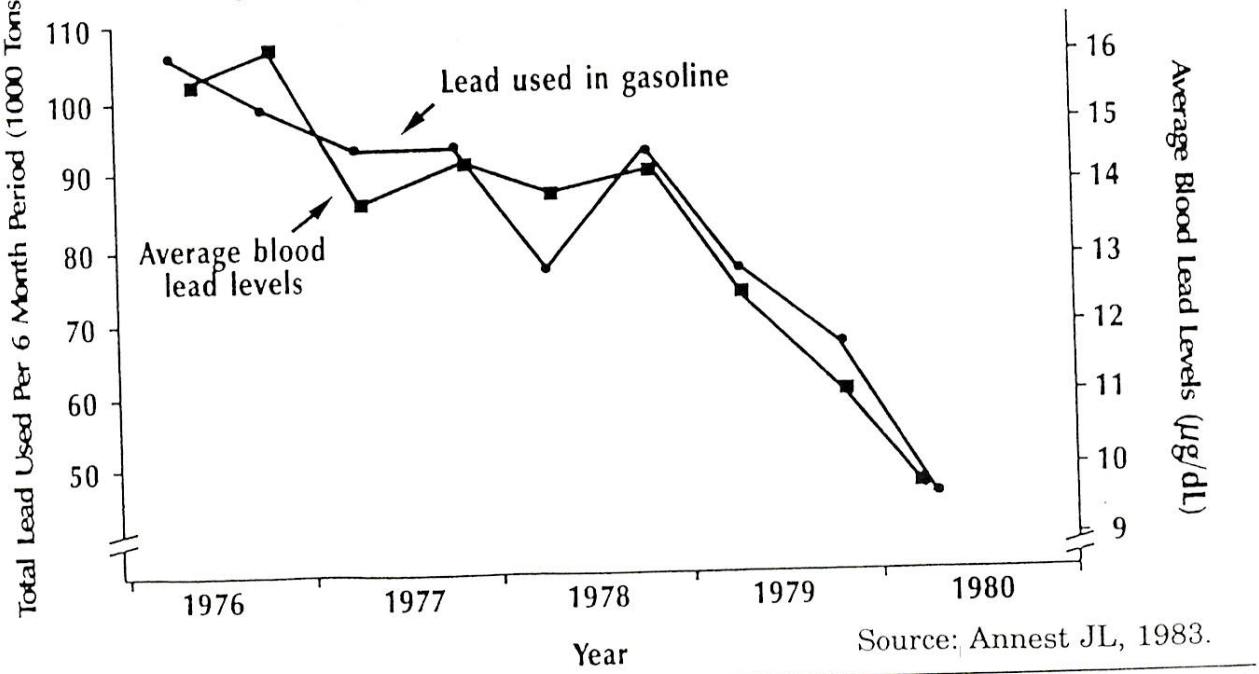
In [an] Italian study (in Turin and Piedmont), lead from the Broken Hill mine in Australia was put in petrol sold in the area for almost two years between 1977 and 1979. This lead has a different ration of the isotopes lead-206 and lead-207 from lead from other sources. So researchers could find out how much of the lead in people's bodies came from this source merely by measuring changes in the isotopic ratios of the lead in their blood. They found that the ratio characteristic of Broken Hill lead dropped by 30 percent for people in Turin after 1979, suggesting that lead from petrol makes up a similar percentage of the total burden of lead in the body.

Dr Joseph Annest from the US National Center for Health Statistics in Hyattsville, Maryland told CLEAR's symposium of similar results from the second US National Health and Nutrition Examination Survey, which covered 27,801 people between 1976 and 1980. The Center for Disease Control in Atlanta analysed samples of blood from 9 933 of these people for lead. Over the four years of the survey, the levels of lead in people's blood dropped significantly and almost exactly in step with the decline in the amount of lead added to petrol, following initiatives to encourage cars to run on unleaded petrol begun in 1975 (see graph).

Four factors make this evidence, produced by Dr Vernon Houk of the Center for Disease Control, especially reliable and convincing. First, the correlation between lead levels in people's blood and the amount of lead added to petrol is very close: the correlation coefficient is 0-95. Secondly, the correlation also held in almost every case when Houk sub-divided the sample into groups defined by age, sex, race, family income, season, region and type (urban or rural) of residence.

Thirdly, a careful control programme showed that the trends were not due to changes in laboratory practice. Throughout the four years of the survey, its designers gave the analysts control samples of bovine blood dosed with a known amount of lead, which they analysed blind. There were no chronological trends in these analyses. Fourthly, the survey is a massive affair, with the result that numbers in most of the sub-groups are large enough to make the results statistically significant.

Graph: In 1975 the US government began to phase out the use of lead in petrol. In the following years, the drop in the amount of lead used was matched by a dramatic drop in the levels of lead in people's blood. The proportion of blood lead that comes from petrol now seems higher than was thought.



Source: Annest JL, 1983.

The Decline in Blood Lead Levels in the United States

by James L. Pirkle, MD PhD; Debra J. Brody, MPH; Elaine W. Gunter; Rachel A. Kramer, ScD; Daniel C. Paschal, PhD; Katherine M. Flegal, PhD, MPH; Thomas D. Matte, MD, MPH

The National Health and Nutrition Examination Surveys (NHANES)

The following abstract is reprinted from the Journal of the American Medical Association (JAMA), July 27, 1994 - Vol 272, No. 4, p. 284.

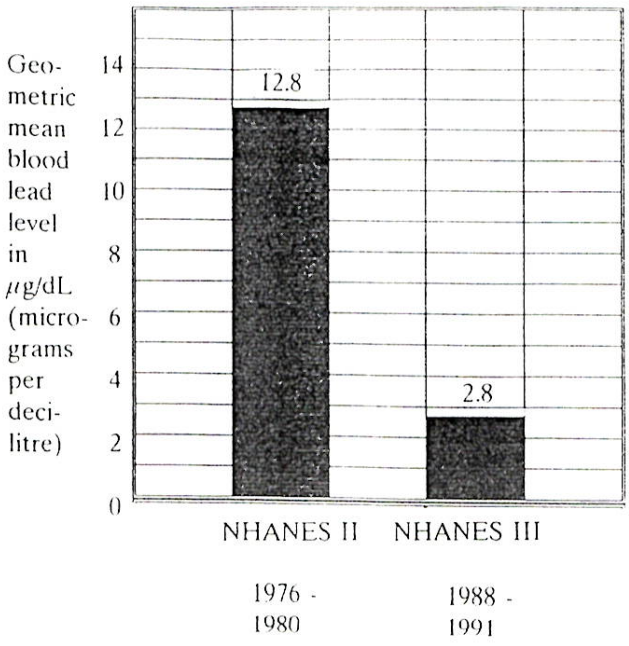
Objective. - To describe trends in blood lead levels for the US population and selected population subgroups during the time period between 1976 and 1991.

Design. - Two nationally representative cross-sectional surveys and one cross-sectional survey representing Mexican Americans in the southwestern United States.

Setting/Participants. - Participants in two national surveys that included blood lead measurements: the second National Health and Nutrition Examination Survey (NHANES II), 1976 to 1980 (n=9832), and phase 1 of the third National Health and Nutrition Examination Survey (NHANES III), 1988 to 1991 (n=12 119). Also, Mexican Americans participating in the Hispanic Health and Nutrition Examination Survey (HHANES), 1982 to 1984 (n=5682).

Results. - The mean blood lead level of persons aged 1 to 74 years dropped 78%, from 0.62 to 0.14 μmol/L 12.8 to 2.8 μg/dL). Mean blood lead levels of children aged 1 to 5 years declined 77% (0.66 to 0.15 μmol/L [13.7 to 3.2 μg/dL]) for non-Hispanic white children and 72% (0.97 to 0.27 μmol/L [20.2 to 5.6 μg/dL]) for non-Hispanic black children. The prevalence of blood lead levels 0.48 μmol/L (10 μg/dL) or greater for children aged 1 to 5 years declined from 85.0% to 5.5% for non-Hispanic white children and from 97.7% to 20.6% for non-Hispanic black children. Similar declines were found in population subgroups defined by age, sex, race/ethnicity, income level, and urban status. Mexican Americans also showed similar declines in blood lead levels of a slightly smaller magnitude over a shorter time.

Conclusions. - The results demonstrate a substantial decline in blood lead levels of the entire US population and within selected subgroups of the population. The major cause of the observed decline in blood lead levels is most likely the removal of 99.8% of lead from gasoline and the removal of lead from soldered cans. Although these data indicate major progress in reducing lead exposure,they also show that the same sociodemographic factors continue to be associated with higher blood lead levels, including younger age, male sex, non-Hispanic black race/ethnicity, and low income level. Future efforts to remove other lead sources (eg, paint, dust, and soil) are needed but will be more difficult than removing lead from gasoline and soldered cans.



"The major cause of the observed decline in blood lead levels is most likely the removal of 99.8% of lead from gasoline and the removal of lead from soldered cans."

Unleaded Petrol Reduces Dioxin Levels in Air

by Dr Chris Winder

One interesting spin-off from taking lead out of petrol has been the reduction in other contaminants being emitted from cars. For example, unleaded cars produce less dioxins and related compounds, recognised as being highly toxic compounds.

Because the lead in petrol can end up in the engine oil, additives were added to petrol to encourage the lead to discharge from the engine in the exhaust gases. These additives, called scavengers, include ethylene dichloride, pentachlorophenate and ethylene dibromide. The lead oxides formed in internal combustion are converted to more volatile lead chlorides and bromides, and out into the exhaust they go.

In 1986, dioxins and related compounds were measured in used motor oil in Germany.[1] In 1987 came the first direct evidence of dioxins and related compounds in car emissions, based on tailpipe measurements taken from four Swedish cars running on petrol containing 0.15 g/L (grams per litre) tetramethyl lead and 0.1 g/L ethylene dichloride as a scavenger. Levels of 20-220 picograms of toxic equivalents of dioxins were emitted for every kilometre driven.[2] Levels of dioxins in two other cars running on unleaded petrol were below the level of detection (that is, less than 13 picograms of toxic equivalents of dioxins for every kilometre driven).

Two other studies repeated and confirmed these measurements, finding:

- 1 picogram of toxic equivalents of dioxins for every kilometre driven for cars using unleaded petrol, and up to 39 pg/km in cars running on leaded in a New Zealand study;[3]
- 0.36-6.3 pg/km (unleaded), 1.1-3.6 (leaded) and not detected in diesel vehicles, in a study in Sweden.[4]

While these numbers are variable, they indicated that the use of chlorinated scavengers in leaded petrol do increase emissions of dioxins and related compounds to air. The original Swedish study suggested that cars using leaded fuel in Sweden emitted 10-100 g of toxic equivalents of dioxins a year. The incremental decrease that will occur from cars using unleaded petrol is one unforeseen benefit from phasing out leaded petrol.

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Car-use Reduction Strategy Pinpoints the Problem

by Anne Roberts, Total Environment Centre

Total Environment Centre (TEC) has developed a car-use reduction strategy which sets out simply and clearly the problems associated with a car-dependent society, and how to overcome them.
An extract from TEC's Car-use Reduction Strategy follows:

Car Dependence is not Inevitable

It is important to realise that there is nothing *pre-ordained* about the dominance of the car. If cars predominate over public transport, and cities are planned around their use, it is a result of deliberate decisions, usually on the part of government or business. Los Angeles is a prime example of a city whose infamous smog and traffic are a result of car dependence imposed by business, acting for its own ends. (See Frank Stilwell, *Reshaping Australia*, Sydney, Pluto, 1993, p60.)

In Australia, planning decisions and an imbalance of funding in favour of roads, have led to urban sprawl and car dependence. More road length per capita is devoted to raods iin Australia than anwhere else in the world, including the USA. (See Newman and Kenworthy, *Winning Back the Cities*, Sydney, ACA and Pluto, 1992, p 10)

Why something has to be done to reduce the number of cars on the road

Air pollution has declined in Sydney and other Australian cities over recent years as a result of restrictions on backyard burning, together with the introiduction of catalytic converters to motor vehicles. Experts warned these improvements will be temporary if the number of cars on the road continues to increase. (McPhail NSW EPA, Sydney Morning Herald 17.8.94; Johnson, in *Summit on Air Quality* 1991). In the two years to March 1994, 200,000 more vehicles were registered in Sydney and there are signs that Sydney's air pollution is beginning to worsen (Total Environment Centre, June 1994).

The Adverse Effects of Car-use

Car use needs to be considered from the point of view of its "total impact". In addition to air pollution, the "total impact" of car use includes:

- Greenhouse gas emissions (21% of Australia's Greenhouse gas emissions are produced by motor vehicles.)
- Lead fall-out from exhaust emissions, with long-term residues in soil
- Destruction of urban bushland
- Urban sprawl
- Destruction and disruption of city and suburbs
- Noise
- Deaths and injuries
- Wildlife killed on the roads
- Economic burden on the individual motorist
- Health infrastructure costs on society
- Anti-social and intimidating behaviour generated by the car.

What has to be Done to Reduce Car-use?

1. share the "trip". Reduce the number of single-occupancy vehicles, and the number of vehicles used for the same "trip purpose."

2. Reduce the number of trips undertaken by car, by reducing the necessity for such trips. Proposals include increasing the density and diversity of suburban areas, and telecommuting.

3. Provide alternatives to the car. Alternatives include a comprehensive public transport system.

4. Introduce incentives and disincentives, to encourage car use reduction. Disincentives must only be introduced when alternatives to car use exist.

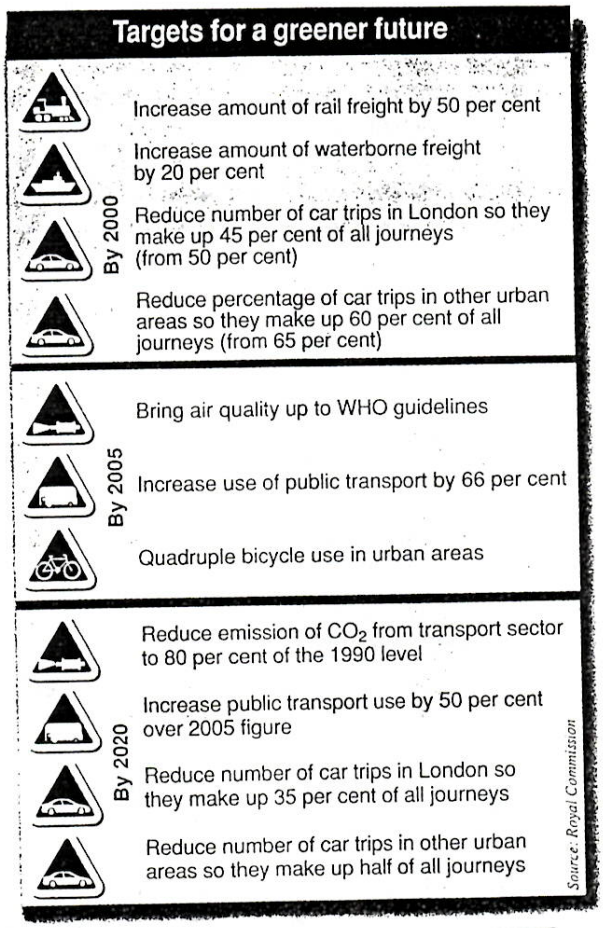
5. Explore minor, but radical options, such as shared ownership of cars beyond the family unit.
We will very briefly discuss items 1 and 3 of the above list. (A copy of the full Strategy may be obtained from Total Environment Centre, Shop 1, Gloucester Walk, the Rocks - at the back of the Immigration Dept building. Postal Address: 1/88 Cumberland Street, Sydney 2000.)

1. **Sharing the ride:** the journey to work lends itself to large-scale car-pooling ("ridesharing") schemes. People who work in large companies, say with upwards of 50 employees all starting work at the one site at approximately the same time might consider asking the employer to set up a car pooling scheme. (TEC calls on the State Govt to require large firms to set up such schemes). Smaller schemes can be set up for taking children to school, or to sport. Organisers of social events could put drivers in contact with one another to "share the ride."

3. **Alternatives** such as a comprehensive public transport system. If your local area has very poor or non-existent public transport, think about complaining - to your council, to your State MP, to State Rail or State Transit, or all of the above, and anyone else you can think of. If there is a public transport service to your area, investigate it - it may be better than you think.

U.K. Targets for a Greener Future

An excellent article from New Scientist, 12 Nov 1994, pp 14-5, reports on the Targets for a Greener Future from the latest United Kingdom Royal Commission on Environmental Pollution. Mick Hamer writes that "The British Government has received its sternest warning yet that its unflagging support for the car is seriously at odds with its own green principles."



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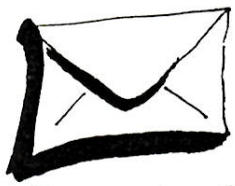


To The LEAD Group:
If your group tries to urge Governments and/or business to cease using lead the following information taken from the Yellow Pages may help in identifying where lead is being used in the Australian environment:

1. A lot of Yellow Pages advertise leadlights and stained glass. This seems a popular hobby now.

2. Cairns Yellow Pages, 1994, p. 523.
   Consolidated Alloys, Chrome St, Salisbury 07 (277 2977) Sheet lead, Aluminium Flashing and Damp Course, Solders and Silicone Sealants, Leadlight Sections.

3. Perth White Pages, 1994, has on page 721 LEAD DISTRIBUTORS 27 Augusta with 4579122. Also the names but no details of products in the Perth Yellow Pages, 1994, on page 1399.

4. Sunshine Coast Yellow Pages, 1994, p. 642.
   Gary Tolhurst, 10 Cadagi Crt, Maroochydore 435072.
   Lead shielding specialist. Internal partitioning.

5. Melbourne Yellow Pages, 1994, page 1563.

A. Australian Lead Development Association
124 Exhibition St, Melb. 6541611.

B. Ballantine Ammunition
Tilburn Road, Deer Park. 3637154

C. B.P.S. Leadburners
613 Geelong Rd Altona North 3145363
Lead fabrication and restoration, Homogeneous linings, Vibration, radiation and sound shielding.

D. Consolidated Alloys
32 Industrial Road Thomastown 3595811
Manufacturers of lead sheet, lead strip, lead pipe, lead rod, lead wire, lead wool, window lead, solders.

E. Statewide Batteries P/L
1457 Centre Road Clayfield 5432144

6. Brisbane, 1995, Yellow Pages, page 1534.

A. Allboards (QLD) P/L 2 Argon St, Carole Park 2615558.
Manufacturer and Supplier of laminated lead sheeting doors and glass, etc for radiation and sound shielding.

B. Castlead works Chrome St Salisbury 2772977.
Window lead.

C. Consolidated Alloys (QLD) Chrome St. Salisbury 2772977.
see 5D above also 1.
lead washers, acrylead, lead roof collars

D. Scott Metals P/L 14 Wellington Rd Woolloongabba 3915999.
Suppliers of sinker and ballast lead.

E. Simsmetal 148 Dunn Rd Rocklea 2773000
Lead ingot, ballast lead.

7. Sydney Yellow Pages, 1994, page 1642

A. Australian Refined Alloys P/L
202 Euston Rd Alexandria 5165230
Specification lead, Lead alloy ingots, Lead alloy castings.

B. Moorebank Plumbing Service
53 Lucas Ave Moorebank 6020996
Manufacturer of lead tanks and coils.

C. Thomas Thoms P/L 83 Morris St Summer Hill 7977811
Copperised lead sheeting, Lead Flashing, Heavy Lead Sheet

8. Adelaide Yellow Pages, 1994, p. 1178

A. Lead Castings P/L Unit 2, 9 Kingston Ave Richmond 3524233
Gravity and Pressure casting, Die design, Tooling.

B. Nonferral (S.A.) P/L Bedford St Gillman 473955
Secondary lead, Antimonial lead ingot

C. Solder-tech P/L 11 Tobruk Ave. St Marys 2768566
Lead Weights

9. Canberra Yellow Pages, 1994
no lead suppliers listed

Please note that some of the above companies are also recycling merchants i.e. buying lead in e.g. lead batteries and smelting it down. I have not listed all lead merchants I have just listed those that show the wide types of lead.

Andrew Gray
Mt Isa, Queensland

Editor's note: thankyou for all your research Andrew. People often ask us where they should buy a house to avoid living near a lead industry. This list should help, in conjunction with historical information on other lead-using activities in the particular area people wish to live in.

Lead Curse Tablets

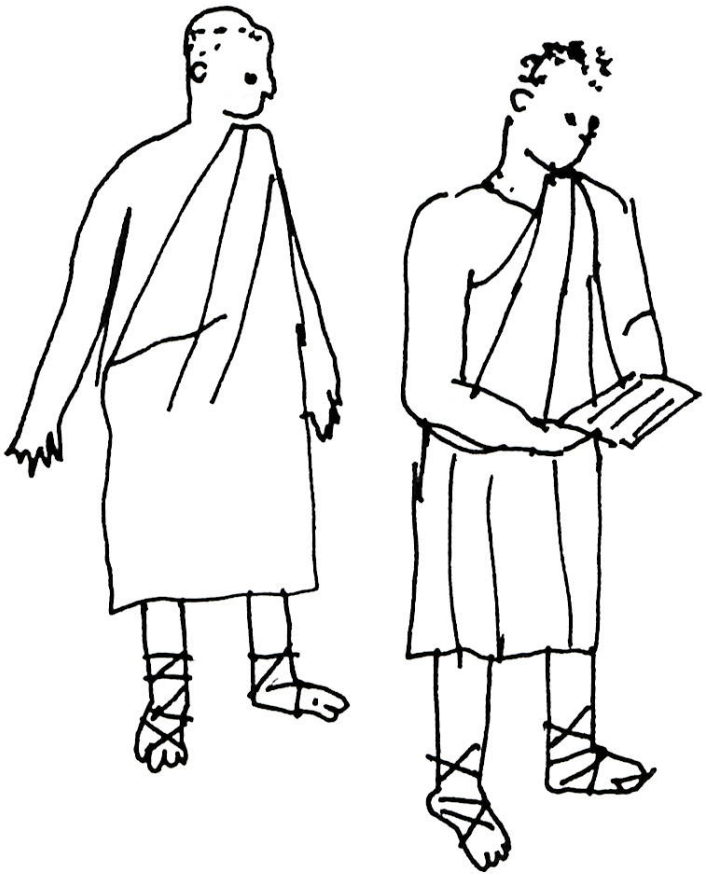
The discovery of a cache of 50 "curse tablets", thrown down a well about 1500 years ago in Israel, may reveal details of ancient quarrels between Roman rivals. Lead tablets found at other sites have included curses by actors and athletes against professional rivals, and by opponents in lawsuits.

The Romans inscribed their curses on soft sheets of lead, folded or rolled them, then threw them into a well, a grave, a spring, or some other place as close to the underworld as possible.

This hoard of tablets, the first discovery of such tablets in Israel, was unearthed at the ancient city of Caesarea Maritima. Kathryn Gleason, leader of the dig from the University of Pennsylvania Museum says "They seem to read like magic potions. It's a 'tongue of newt' kind of formula."

The secrets of these scrolls should soon be revealed. Deciphering is to begin in January 1995.

Reference: New Scientist (Kurt Kleiner) 19 November 1994.



The History of Lead

by Christopher Winder

This is the fourth in a series of extracts from Dr Winder's History of Lead, from his book "The Developmental Neurotoxicity of Lead", published by MTP Press Ltd 1984. Reprinted with kind permission.

The Roman Empire

Although its importance initially lay in its close association with silver, lead emerged from the background and assumed a dominant role in the technology of the developing Roman Empire. Amongst other reasons, the Roman invasion of Britain in the first century was launched to exploit the lead [and tin, copper and silver] mines of England, to satisfy the Roman enthusiasm for sanitation and bathing. The latin word for lead was *plumbum,* denoting water conduits or spouts; the word plumber is derived from it.

Lead-lined pots were used extensively in cooking, as they prevented the bitterness caused by using bronze containers, imparting a sweet flavour to food. Wine was also prepared in lead-lined containers, specifically because of this sweetening property. The ability of lead to inhibit enzyme activity was well appreciated as a preservative for fruit and wine. Both Cato [De re rustica, cv] and Pliny [Historia naturalis, xiv, 21; translation of Jones and Rackham, 1938-1963] advocated the treatment of wine in leaden vessels. These practices caused considerable contamination of food and drink, and Gilfallen [1966] has proposed the doubtless excessive idea that the fall of Rome was due to endemic lead poisoning.

Together with reports of the use of lead are descriptions of its toxic side-effects. These were known to ancient physicians, and the first report is ascribed to Hippocrates [370 BC] who noted symptoms of a metal colic in a metal worker [Jones and Withington, 1923-1931]. However, there is no reason to believe that this colic was due to lead, so that this supposition is based more on recent tradition than fact [for a discussion of the issues involved, see Waldron, 1973]. The first accurate account of lead poisoning is probably that in the Therica and Alexipharmaca [i, 600] of Nicander [2nd century BC], who described symptoms of poisoning by ceruse [white lead] as constriction of the palate and gums, asperity of the tongue, hiccups, a dry cough, nausea, heaviness of the head, unnatural vision and torpor [Major, 1965].

Of the Romans, Vitruvius [1st century BC] mentions that water impregnated with lead was injurious [On Architecture, viii, 3], and noted the pallid appearance of lead workers. Horace [1st century BC] is another of the writers of antiquity to mention the purity of water in relation to lead pipes. In a letter to an old friend, he extolled the virtues of living in the countryside, comparing amongst other things, the purity of town water to fresh countryside water.

> *Purior in vicis aqua tendit rumpere plumbum*
> *Quam quae per pronum trepidat cum murmure rivum?*
> (Horace Epist., I, 10, 20-21; translation of Wickham, 1891).

Lead has been used as a remedy for thousands of years. It is mentioned in the Ebers papyrus (1550-1500 BC), an Egyptian medical treatise. Lead is specified for laying on a wound (for cooling?). Some Egyptian medical recipes were given by later authors, including Dioscorides, Pliny and Galen. Litharge was the *'spuma argenti'* of Celsus (1st century BC) who mentioned is as a cooling and cleansing medicine. He also treated ceruse as a poison (*De Medicina,* v, 27, 15) but recommended it for burns and ulcers (ibid., v,7,). Pliny (the elder, 23-79 AD) noticed the deleterious effects of exhalations from lead mines (*Historia Naturalis,* xxxiv, 47, 50; translation of Jones and Rackham, 1938-1963), and dioscorides (1st century AD), noted the toxic side-effects and some early attempts at industrial hygiene in the Roman shipbuilding industry (*De venenis).* In his *De universa medicina* is found the first mention of lead (as the acetate) as a remedy. He also recommends washed litharge as a remedy for ophthalmic problems, unseemly scars, wrinkled faces and refrigerant properties of lead (Goodyer and Gunther, 1934). Galen (138-201 AD) mentions that water conveyed in leaden pipes sometimes causes dysentery (*Med. Sec. Loc.,* vii), and expressly says that ceruse ought not to be administered internally (*Methodus Medendi,* iv). For a fuller explanation of roman sources see Scarborough (1969).

With the growth of the byzantine empire and the transfer of power to the east, Constantinople became the centre of medical knowledge in Europe. The early Byzantine authors tended to

paraphrase their Roman predecessors and Oribasius (325-403 AD) and Aetius (early sixth century) both quote many of the Greek and Roman writers. The greatest Byzantine physician is Paul of Aegina (626-690 AD). His report of an epidemic of colic terminating in paralysis is the earliest known description of the clinical picture of lead poisoning (*De Re Medica,* iii; translation of Adams, 1864-1867). He also had a novel use for lead - 'a plate of lead worn upon the loins restrains libidinous dreams'.

Following the collapse of European culture in the 6th-8th centuries, medical knowledge and practice became fossilised in the hands of the church. It was only in the expanding Moslem world that intellectual inquiry continued. The early Arabian physicians, such as Rhazes (865-925 AD) and Serapion (9th century) tended to be bound by the authority of the ancients, supplying little or no additional information. The sue of lead as a remedy however, was expanded. It was recommended generally as an astringent in fetor of the armpits to restrain sweating, and to dispel extravasated blood. It does not appear to be used internally, although Avicenna (980-1037 AD) mentions its usage in fluxes and ulceration of the intestines (*Q'anun*, ii, 2, 460; translation of Gruner, 1930). Ibn Baithar (1197-1248 AD) recommended it for diarrhoea, and reported it as being useful in congenital hernia and other complaints around the scrotum.

Although some of these early reports may contain inaccuracies owing to contamination with other toxic metals (notably arsenic, bismuth and antimony), reported symptoms of colic, palsy and paralysis compare favourably with current descriptions.

About The LEAD Group

The LEAD Group is a non-profit community group, set up in 1991 by parents of lead poisoned children and individuals who were appalled at the government's lack of services to address the needs of children affected by lead, and lack of a comprehensive strategy to prevent this most common environmental health problem.

The LEAD Group's aims are to prevent childhood lead poisoning in Australia by the year 2002, and to protect the environment from lead. "Childhood lead poisoning" is here defined (as it is by the Centers for Disease Control and Prevention in the US), as a foetus, infant or child having a blood lead level above 10 μg/Dl (micrograms per decilitre). This equates to 0.48 μmol/L (micrograms per litre).

The LEAD Group is an incorporated association funded in 1994 for the first time by a government grant of $10,000 from the federal Department of Environment, Sport and Territories and by donations and membership fees. The funding provides limited operating expenses for telephone, fax, photocopier, internet fees, newsletter publication and postage, but not wages.

The LEAD Group is made up of membership, volunteers, and a technical advisory board. The volunteers carry out all our services to the community, mostly from our office, the Community Lead Information Centre (CLIC) in Sydney. Our name, The LEAD Group, is an acronym for the **L**ead **E**ducation and **A**batement **D**esign Group and is intended to convey the two areas in which we operate: firstly, education (and counselling), and secondly, lobbying and policy development for lead abatement (or lead risk reduction).

i) Information and Counselling

LEAD Group volunteers have carried out the following services:
telephone counselling for parents and carers of lead poisoned children. (People from all over Australia have been referred to our telephone counselling service, after calling the Australian Environment Protection Agency's (EPA's) Lead Hotline (free call 008 803 772), NSW Department of Health, NSW EPA and Public Health Units);
awareness raising about the problems of lead in non-point source communities in Australia;
an excellent library (available to the public) covering all aspects of lead;
posted out sets of free information sheets, the most credible around being from a non-industry non-government source;
conducted or organised numerous counselling sessions and information nights for groups of parents of lead-affected children. has given numerous talks to parents and students in all inner Sydney Council areas.

ii) Lobbying and policy formulation

*** At the Local government and community level**
The LEAD Group has:

been active in Environment policy development with both Leichhardt Council and Ashfield Council
networked with other community groups;

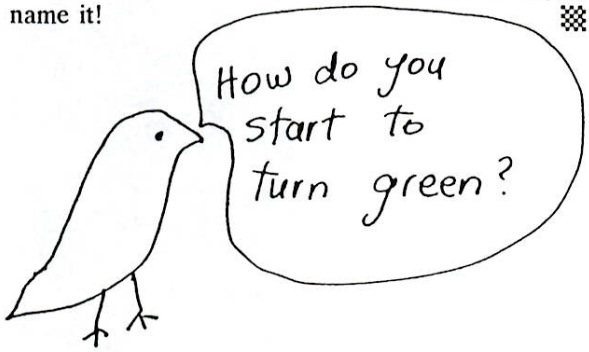
* **At the State government level** The LEAD Group has:
held public meetings in inner Sydney;
successfully lobbied for blood lead testing of 1-4 year-olds in Summer Hill, in inner western Sydney;
played a major role in bringing about the NSW Lead Issues Paper and setting up of the NSW Lead Taskforce;
provided community representatives on 8 of the 9 Working Groups of the NSW Lead Taskforce;
lobbied other State governments to develop a strategy for lead poisoning prevention.

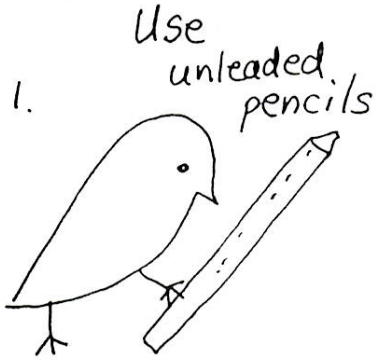
* **At the national level** The LEAD Group has:
successfully lobbied for a change in the blood lead level. The old "level" of concern of 25 μg/Dl was replaced with a series of blood lead "action levels" and a national goal of 10 μg/Dl;
been involved with the National Health and Medical Research Council (NHMRC) in workshops to design a national strategy on lead abatement ("Reducing Lead Exposure in Australia", July 1993);
successfully lobbied for reduced use of lead in petrol. A 50% reduction in the lead level of petrol has been agreed to and will be completed by the end of 1994;
encouraged the lead abatement industry, especially manufacturers of products with potential for export;
circulated our newsletter nationally.

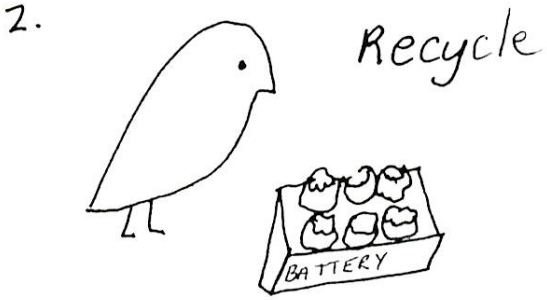
* **At the International level** The LEAD Group has:
contributed to an OECD lead monograph and the development of an OECD Lead Control Act;
spoken at Newcastle and Washington International Conferences;
unsuccessfully lobbied delegates from Australia and other countries for an international agreement on the phase-out of lead in petrol and food cans at the meeting of the Commission on Sustainable Development at the United Nations in New York in May 1994.

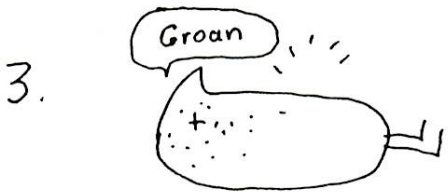
Plans for the future - how you can help

The LEAD Group will continue to do everything necessary to achieve our aims, but would also like to help communities in other countries affected by lead poisoning, through the internet. With such a broad range of functions, we need volunteers (from anywhere in Australia or the world) over an incredibly wide range of skills - from putting stamps on envelopes to talking at the United Nations. If you can't spare the time to help, perhaps you can make a donation - money, stamps, articles on lead, filing cabinets, paper, you name it!









Eat too much trifle

The Ancient World was Poisoned by Lead

by John Emsley

Reprinted from New Scientist, 1 October 1994 p 14

Who says pollution is a modern problem? French geologists have discovered that snow falling at the time of the Ancient Greeks and Romans contained an unexpectedly high concentration of lead. The amount of lead precipitated from the atmosphere between 500 BC and 300 AD totalled 15 per cent of the lead pollution caused this century by leaded petrol. The team also found higher than expected levels of lead pollution for the Middle Ages, running from around 1000 AD to 1500 AD.

In this century, lead levels in the air began to climb in the early 1930s, when tetraethyl lead was introduced to boost the performance of petrol. Since then, emissions from cars have polluted not only cities and roadsides, but the whole planet.

A team led by Claude Boutron of Domaine University, Grenoble, has now found that earlier civilisations also contaminated the planet with lead. They report levels of the metal four times as high as natural background levels (*Science*, vol 265, p 1841).

Boutran and his colleagues analysed 22 sections of a core 3000 metres long which was drilled at Summit, Greenland, by scientists on the Greenland Ice-Core Project. The researchers selected ice layers corresponding to a period 1360 to 1775 years ago. They also analysed sections from before and after this time.

In an ultraclean cold room, the geologists used a lathe made entirely of polyethylene to shave samples from the ice core. The lead it contained was measured using a device known as a graphite furnace atomic absorption spectrometer. The researchers also measured the levels of sodium and aluminium in the ice and also used an artificial ice core, made from ultrapure water, as a control.

By comparing shavings from the surface of the core with those from deeper within, the scientists discovered that the bit that was used to drill the ice core contaminated the outer layers slightly but that the deeper layers were pristine. While the level of lead varied over the years, the levels of aluminium and sodium did not.

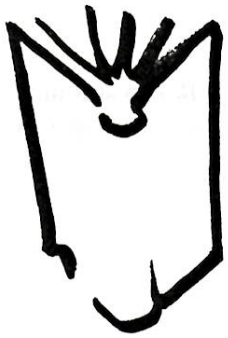
The researchers found that the lead level rose from a natural background, arising from rock dust and volcanoes, of about 0-5 picograms per gram of ice to about 2 pg/g at the time of Christ. By AD 500, it had fallen to the natural level. The lead level began to rise again around AD 1000, reaching 4 pg/g by AD 1500. This increase in the Middle Ages was caused by extensive mining and smelting of silver and lead in Germany.

The mining of lead on a large scale began in Greece about 500 BC with the advent of silver mining near Athens. Galena, a grey mineral which contains a small percentage of silver, is mainly lead sulphide. To extract the silver, the Greeks roasted the ore and then cupelled the molten metal. Cupelling involved heating the metal in a pot with a blast of hot air to oxidise the lead, which was then skimmed off.

Lead first became an important commercial metal at the time of the Roman Empire, when people used it for cisterns, roofing, pipes and paints. They even used its salts as the artificial sweetener *sapa*. City dwellers were exposed to high levels of lead in their diet, as has been shown by the analysis of human bones disinterred in Rome. Some have suggested that this explains the empire's eventual decline.

The Romans mined lead in many parts of the empire,including Britain, but especially in Spain. More than 80 000 tonnes of lead per year were produced when mining was at its height, and Boutron estimates that the open-air furnaces then in operation would have released about 5 per cent of it into the atmosphere. Some reached the middle troposphere and was deposited in snow in the polar regions.

Boutron calculates that over the 800 years of Ancient Greek and Roman civilisation, a total of 400 tonnes of lead reached Greenland.



Lead in Literature

This is the second half of "Lead" a chapter from The Periodic Table, a book by Primo Levi. The first half was reprinted in LEAD Action News Vol 2 No 3.

First published in Great Britain by Michael Joseph Ltd 1985. Published in Abacus by Sphere Books Ltd 1986, London. English translation copyright 1984 by Shocken Books Inc. Italian text copyright 1975 Giulio Einaudi editore. s.p.a., Torino Published by agreement with Einaudi Editore SpA, Turin.

...many reasons impelled me to continue my journey. First: I wanted to see the warm countries, where they say olives and lemons grow. Second: I wanted to see the sea, not the stormy sea from which came my ancestor with the blue teeth, but the tepid sea, from which comes salt. Third: there's no point in having gold and carrying it on your back, with the continuous terror that at night or during a drinking bout someone will steal it from you. Fourth, and to sum up: I wanted to spend the gold on a sea voyage, to get to know the sea and sailors, because sailors need lead, even if they do not know it.

So I left: I walked for two months, descending a large sad valley until it opened out on a plain. There were meadows and wheat fields and a sharp smell of burnt brushwood which filled me with nostalgia for my country: autumn, in all the countries of the world, has the same smell of dead leaves, of resting earth, of bundles of burning branches, in short, of things which are ending, and you think "forever." I came across a fortified city - there are none as large back home - at the confluence of two rivers; there was a market fair with slaves, meats, wine; filthy, solid, dishevelled girls; a tavern with a good fire - and I spent the winter there: it snowed as it does back home. I left in March, and after a month of walking I found the sea, which was not blue but gray, bellowed like a bison, and hurled itself on the land as though it wanted to devour it: at the thought that it never rested, never had rested since the beginning of the world, my courage failed me. But I still continued down the road to the east, along the beach, because the sea fascinated me and I could not tear myself away from it.

I found another city, and I stopped there, also because my gold was beginning to come to an end. They were fishermen and strange folk, who came by ship from various, very distant countries: they bought and sold; at night they fought over the women and knifed each other in the alleyways. Then I too bought a heavy knife made of bronze in a leather sheath, to carry tied to my waist under my clothes. They knew glass but not mirrors; that is, they only had small mirrors of polished bronze, cheap things, the kind that get scratched immediately and distort the colours. If you have lead it is not difficult to make a glass mirror, but I made a fuss about parting with the secret, I told them that it is an art which only we Rodmunds know, that a goddess named Frigga taught it to us, and other foolishness which they swallowed hook, line, and sinker.

I needed money: I looked around me, found near the port a glazier who seemed rather intelligent, and made a deal with him.

From him I learned several things - first of all, that glass can be blown: I liked that system a great deal, and I even had him teach it to me, and one day or another I will also try to blow lead or melted bronze (but they are too liquid, I doubt whether I'll succeed). I, however, taught him that on a still-hot pane of glass you can pour melted lead and obtain mirrors not so large but luminous, without flaws, which last for many years. He in fact was rather adept: he had a secret for making coloured glass and fashioned variegated glass panes that were beautiful to look at. I was full of enthusiasm for the collaboration and invented a process of making mirrors also with the rounded caps of blown glass, pouring the lead into it or spreading it on the outside: if you looked into them you see yourself either very large or very small, or even all crooked: these mirrors are not liked by women, but all children insist on getting them. Through the summer and fall we sold mirrors to the merchants, who paid well for them; but meanwhile I was talking with them and tried to gather as much information as I could on a region which many of them knew.

It was astounding to see how those people, who actually spent half their lives on the sea, had such confused notions about the cardinal points and distances; but, in short, on one point they were all agreed: that is, that by sailing south, some said a thousand miles, others said ten times farther than that, you came to a land which the sun had burnt to dust, rich in unusual trees and animals, and inhabited by ferocious men with black skin. But many stated as a certainty that halfway along you encountered a large island called Icnusa, which was the island of metals: they told the strangest stories about this island, which was inhabited by giants, whereas the horses, oxen, even rabbits and chickens were tiny; that the women gave orders and fought the wars, while the men watched over the livestock and spun the wool; that these giants were devourers of men, especially foreigners; that it was a land of utter whoredom, where the husbands exchanged wives and even the animals coupled haphazardly, wolves with cats, bears with cows; that the women's period of pregnancy lasted only three days, then the women gave birth and immediately told the infant: "Get moving, bring me the scissors and turn on the light, so I can cut your umbilical cord." Still others said that along its coasts there are fortresses built of rock, big as mountains; that everything on that island is made of rock - the points of the spears, the wheels of the wagons, even the women's combs and sewing needles: also the pots to cook with, and that they actually have stones which burn and they set them alight under these pots; that along their roads, to guard the crossroads, there are petrified monsters frightening to look at. I listened to all these things with a grave face, but within myself I was laughing loud enough to burst, because by now I have roamed the world enough and know that all is just like your hometown: for the rest, I too, when I get back and tell stories about the countries I've been in, amuse myself by inventing weird tales; indeed, here they tell fantastic stories about my country - for example, that our buffalo do not have knees and all you have to do to slaughter them is saw through the trees against which they lean at night to rest: their weight breaks the tree; they fall down and cannot get up again.

As to metals, however, they were all in agreement: many merchants and sea captains had brought loads of raw or finished metal from the island to land, but they were crude folk and from their accounts it was hard to understand what metal they were referring to; also because not all spoke the same language and no one spoke mine, and there was a great confusion of terms. They said, for example, "kalibe" and there was absolutely no way to figure out whether they meant iron, silver, or bronze. Others called "sider" either iron or ice, and they were so ignorant as to insist that the ice in the mountains, with the passing of the centuries and beneath the weight of the rock, hardens and first becomes rock crystal and later iron-bearing rock.

To put it bluntly, I was fed up with these female occupations and wanted to go and see this Icnusa. I handed over to the glazier my share in the business, and with that money, plus the money I had made from the mirrors, I got passage on board a cargo ship; but you don't leave in the winter, there is the north wind, or the west wind, or the south wind, or the southwest wind - in brief, it appears that no wind is good, and that until April the best thing is to stay on land, get drunk, bet your shirt on the dice games, and get some girl in the port pregnant.

We left in April. The ship was loaded with jugs of wine; besides the owner there was the crew chief, four sailors, and twenty rowers chained to their benches. The crew chief came from Kriti and was a big liar: he told stories about a country where there lived men called Big Ears, who have ears so huge that they wrap themselves in them to sleep in the winter, and about animals called Alfil with tails in the front who understand the language of men.

I must confess that I had trouble accustoming myself to life aboard ship: it dances under your feet, leans a bit to the right and a bit to the left, it is hard to eat and sleep, and you step on each other's feet due to the lack of space; besides, the chained rowers stare at you with such ferocious eyes as to make you think that, if they weren't in fact chained, they would tear you to pieces in a flash: and the owner told me that sometimes it happens. On the other hand, when the wind is favourable, the sail billows out, the rowers lift their oars, and you think you are flying in an enchanted silence; you see dolphins leap out of the water, and the sailors claim that they can discover, from the expression on their snouts, the weather we will have the next day. That ship was well plastered with pitch and yet the entire keel was riddled with holes; they were ship worms, they explained. In port, too, I had seen that all the moored ships were worm-eaten: there was nothing to be done, said the owner, who was also the captain. When the ship is old, it's broken up and burnt; but I had an idea, and the same for the

anchor. It's stupid to make it out of iron; the rust devours it, and it doesn't last two years. And fishing nets? Those sailors, when the wind is good, dropped a net that had wooden floats and rocks as ballast. Rocks! If they had been lead they could have been four times less cumbersome. Of course I did not say a word to anyone, but - as you too will understand - I was already thinking of the lead I would dig out of Icnusa's entrails, and I was selling the bearskin before I had shot the bear.

We came in sight of the island after eleven days at sea. We entered a small harbor by rowing; around us there were granite cliffs and slaves who were carving columns. They were not giants and they did not sleep in their own ears; they were made like us and communicated well enough with the sailors, but their guards did not let them speak. This was a land of rocks and wind, which I liked on sight: the air was full of the smell of herbs, bitter and wild, and the people seemed strong and simple.

The land of metals was two days' walk away: I hired a donkey with a driver, and this is actually true, they are small donkeys (though not like cats, as they say on the mainland) but robust and tough; in short, in all rumours there may be some truth, perhaps a truth hidden beneath veils of words, like a riddle. For example, I saw that the story of the rock fortresses was quite correct; they are not as big as mountains, but solid, regular in shape, with hewn stones fitted together with precision. And what is curious is that everyone says that "they have always been there," and nobody knows by whom, how, why, and when they were built. That the islanders devour foreigners, however, is a great lie. Going in stages they led me to the mine without making any difficulties or indulging in mysteries, as if their land belonged to everyone.

The land of metals is enough to make you drunk, as happens when a hound enters a wood full of game and jumps from scent to scent, shivering all over and going half crazy.

It is near the sea, a line of hills which on high become rocky crags, and near and far, all the way to the horizon, one sees plumes of smoke from the foundries, surrounded by people working, free and slaves: and the story of the stone that burns is also true; I could scarcely believe my eyes. It doesn't catch fire easily, but then it produces a great deal of heat and lasts for a long time. They brought it there from God knows where, in baskets on donkeys' backs - it is black, greasy, fragile, and not very heavy.

So, as I was saying, there are marvellous stones, certainly heavy with metals never seen, which surface in white, violet, and blue streaks: beneath that land there must be a fabulous tracery of veins. I would willingly have lost myself in it, tapping, digging, and testing; but I am a Rodmund, and my rock is lead. I immediately set to work.

I found a deposit on the country's western border, where I believe nobody had ever searched: in fact, there were no pits, nor tunnels, nor heaps of rubble, and there weren't even any signs on the surface; the rocks on the surface were like all the other rocks. But just below, the lead was there: and this is a thing of which I had often thought, that we prospectors believe we find the metal with our eyes, experience, and skill, but in reality what guides is something more profound, a force like that which guides the salmon to go back up our rivers, or the swallows to return to the nest. Perhaps it happens with us as with the water diviners, who do not know what guides them to the water, but something does guide them and twists the wand in their hands.

I can't say how, but right there was the lead: I felt it under my feet, turbid, poisonous, and heavy, stretching for two miles along a brook in a wood where wild bees nest in the lightning-struck tree trunks. In a short time I had bought slaves who dug for me, and as soon as I had laid aside a bit of money I also bought myself a woman. Not just to have a good time: I chose her carefully, not looking so much for beauty but rather that she be healthy, wide in the hips, young, and merry. I chose her like that, so that she gives me a Rodmund, and our art does not perish; and I haven't been behindhand, because my hands and knees have begun to shake, and my teeth are loose in my gums and have turned blue like those of my ancestor who came from the sea. This Rodmund will be born at the end of the coming winter, in this land where palms grow, salt condenses, and at night you can hear the wild dogs baying on the track of a bear. In this village I have founded near the brook of the wild bees, and to which I would have liked to give a name in my language, which I am forgetting, *Bak der Binnen*, meaning "*Brook of the Bees*": but the people here have accepted the name only in part, and among themselves, in their language, which by now is mine, they call it *Bacu Abis*.

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